

CONTRACT DOCUMENTS FOR:



# DEPARTMENT OF VETERANS AFFAIRS

PROPOSED COMMUNITY BASED OUTPATIENT CLINIC

#36C24W22R004

2191 MARION AVENUE  
NORTH BEND, OREGON 97459

**100% COMPLETE CD'S**

ARCHITECT'S PROJECT NO. 21050

DATE: October 7<sup>th</sup>, 2022

ARCHITECTURAL + MEP

## PACKAGE TWO - TI INTERIORS PORTION OF THE PROJECT

PACKAGE ONE IS THE TI/ INTERIORS PORTION OF THE PROJECT



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VETERANS ADMINISTRATION CLINIC BUILDING ADDITION  
TENANT IMPROVEMENT CONSTRUCTION  
2191 MARION ST., NORTH BEND, OREGON  
PROJECT NO. 21050

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PROJECT TITLE PAGE**

**PROJECT MANUAL  
FOR  
NORTH BEND VA CBOC  
PROJECT NUMBER: 21050  
2191 MARION STREET  
NORTH BEND, OREGON 97459**

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**SECTION 010350  
MODIFICATION PROCEDURES**

**PART 1 – GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to Work of this Section.

**1.02 SUMMARY**

- A. This Section specifies requirements for handling and processing Contract modifications.

**1.03 RELATED SECTIONS: THE FOLLOWING SECTIONS CONTAIN REQUIREMENTS THAT RELATE TO THIS SECTION.**

- A. Division 1 Section "Submittals"
- B. Division 1 Section "Application for Payment"
- C. Division 1 Section "Product Substitutions" for administrative procedures for handling requests for substitutions made after award of the Contract.

**1.04 CLARIFICATIONS OR MINOR CHANGES IN THE WORK**

- A. Instructions for document clarification or authorizing minor changes in the Work, not involving an adjustment to the Contract Sum or Contract Time, will be issued by the Architect as a Field Order or as an Architect's Supplemental Instructions or be documented in the Architect's Construction Progress Report. A Request for Information (RFI) response may also be used for document clarification or authorization of minor changes in the work.

**1.05 REQUESTS FOR INFORMATION (RFI)**

- A. Section specifies administrative and procedural requirements for handling and processing Requests for Information (RFI).
- B. RFI is intended for requesting clarifications and interpretations of Contract Documents due to apparent inconsistencies, errors or omissions in Contract Documents or due to unanticipated existing conditions.
- C. RFI is not intended for requesting substitutions, Contractor or Subcontractor's proposed changes, resolution of nonconforming work or for general questions not related to Contract Documents.

**1.06 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS**

- A. Requests for clarification or errors, inconsistencies or omissions discovered in Contract Documents shall be reported promptly to Architect as an RFI.
- B. In event of inconsistency between portions of Contract Documents or within Contract Documents; provide better quality or greater quantity of Work and comply with more stringent requirement.
- C. Contractor and Subcontractors are not required to ascertain Contract Documents are in accordance with applicable laws, statutes, ordinances, codes and rules and regulations, unless they bear upon construction means, methods, techniques, or safety and health precautions, however, the Contractor or Subcontractor shall promptly report to Architect any nonconformity discovered by or made known as a RFI.
- D. If Contractor or Subcontractor knowingly proceeds with Work affected by known errors or omissions in Contract Documents, Contractor or Subcontractor shall correct any such errors, inconsistencies, or omissions at no additional cost.

### **1.07 CONTRACTOR'S RESPONSIBILITIES**

- A. When interpretation, clarification or explanation of portion of Construction Documents is needed by Contractor, Subcontractor, Vendor or Supplier, the request shall be processed through Architect.
- B. Contractor shall review request for completeness, quality, proper referencing to drawing or specification section and reason submitted.
- C. If request is not acceptable return to submitter with comments regarding reason for return.
- D. List specific Contract Documents researched when seeking information being requested. Reference all applicable Contract Drawings by sheet number, section, detail, room number, door number, etc., Specifications by section, page and line number.
- E. The field titled "Regarding" on attached RFI form must be clear for future reference in reports or correspondence.
- F. Clearly state request, include sketches, photos or other reference material.
- G. Fully assess issues, suggest any reasonable solutions and include various factors, including potential costs, schedule impacts, if any, and recommendations which will aid in determining a solution or response. If a reasonable solution cannot be suggested, a statement to that effect should be stated.
- H. Any critical RFI's requiring a rapid response shall clearly indicate such with an explanation as to why RFI is critical.
- I. Priority for responses shall be indicated when multiple RFI's are submitted within short period of time.
- J. Copies of responses to RFI's shall be distributed to all parties affected.
- K. A response to RFI shall not be considered a notice to proceed with a change that may revise the Contract Sum or Contract Time, unless authorized in writing.
- L. If response to RFI is determined incomplete, it shall be resubmitted with reason response is unacceptable and any necessary additional information within five (5) days' time of receipt of response to RFI.
- M. If additional cost or time is involved because of clarifications, interpretations or instructions issued by Architect and if no other solution is possible or desirable, submit Claim in accordance with the Contract Documents with five (5) days of receipt response to the RFI.

### **1.08 RFI SUBMITTAL FORMAT**

- A. Request for Information shall be submitted to Architect on RFI form.
- B. RFI's shall be assigned unique numbers in sequential order (1, 2, 3, 4, etc).
- C. A resubmitted RFI or a previously answered RFI requiring further clarification shall be submitted using original RFI number followed by ".1" to indicate revision of RFI (i.e.: RFI No. 34.1 for revision to RFI No. 34).
- D. RFI form shall be electronically filled out and emailed to Architect in text file format. Attachments shall be in electronic text or PDF file format. Photo attachments may be in JPG format.

### **1.09 ARCHITECT'S RESPONSE TO REQUEST FOR INFORMATION (RFI)**

- A. Clarifications, interpretations and decisions of Architect in response to RFI will be consistent with intent of and reasonably inferable from Contract Documents.
- B. Architect's decisions on matters related to aesthetic effects will be final and consistent with intent expressed in Contract Documents.

- C. Architect shall provide responses to RFI's with reasonable promptness, but will endeavor to respond with seven (7) days from date or receipt.
- D. If multiple RFI's are submitted on same day or within a five (5) day period, review time may be extended by mutual agreement of parties.
- E. Architect will provide a written response to RFI if Architect believes response only involves an interpretation, clarification, supplemental information or orders a minor change in Work not involving an adjustment in Contract Sum or extension of Contract Time.
- F. If Architect believes response may result in a change to Contract Sum or Contract Time, response will indicate that a Contract change document will be issued with the response.
- G. Architect will provide any additional or supplemental drawings, specifications or other information as necessary to facilitate response.
- H. Architect may return RFI without response for following reasons: RFI is:
  - 1. Unclear.
  - 2. Incomplete.
  - 3. Related to construction means, methods or techniques.
  - 4. Related to health or safety measures.
  - 5. Due to lack of adequate coordination.
  - 6. Considered a "Substitution Request."
- I. Request for Information Form: Use form provided. Sample copy included in Contract Forms Section.

#### **1.10 PROPOSAL REQUESTS**

- A. Owner Initiated Proposal Requests: Proposed changes in the Work that will require adjustment to the Contract Sum or Contract Time will be issued by the Architect on the Architect's Proposal Request Form (reference Contract Forms), with a detailed description of the proposed change and supplemental or revised Drawings and Specifications, if necessary.
  - 1. Proposal Request issued by the Architect are for information only. Do not consider them as instructions either to stop work in progress, or to execute the proposed change.
  - 2. Unless otherwise indicated in the Proposal Request, within five (5) working days of receipt of the Proposal Request, submit to the Architect for the Owner's review an estimate of cost necessary to execute the proposed change.
    - a. Include a list of quantities of products to be purchased and unit costs, along with the total amount of purchases to be made.
    - b. Include a breakdown of labor required for the change.
    - c. Include credits that may result for labor and/or materials included in the Contract that are no longer required.
    - d. Include applicable taxes, delivery charges, equipment rental and amounts of trade discounts.
    - e. Include a statement indicating the effect the proposed change in the Work will have on the Contract Time.

#### **1.11 CONTRACTOR INITIATED PROPOSAL REQUESTS: WHEN UNFORESEEN CONDITIONS REQUIRE MODIFICATIONS TO THE CONTRACT, THE CONTRACTOR MAY PROPOSE CHANGES BY SUBMITTING A PROPOSAL REQUEST FOR A CHANGE TO THE ARCHITECT.**

- A. Include a statement outlining the reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and Contract Time.
  - 1. Include the breakdowns of cost as described above for Owner Initiated Proposal Requests.
  - 2. Comply with requirements in Division 1, Section "Product Substitutions," if the proposed change in the Work requires the substitution of one product or system for a product or

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system specified.

3. Request forms will not be processed by Architect until all information under Owner Initiated Proposal Requests above have been provided.
- B. Proposal Request Form: Use forms provided. Sample copy included in Contract Forms Section.

**1.12 CONSTRUCTION CHANGE DIRECTIVE**

- A. Construction Change Directive: When the Owner and Contractor are not in total agreement on the terms of a Proposal Request, the Architect may issue a Construction Change Directive on AIA form G714, instructing the Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
1. The Construction Change Directive will contain a complete description of the change in the Work and designate the method to be followed to determine change in the Contract Sum or Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of Work required by the Construction Change Directive.
1. After completion of the change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

**1.13 CHANGE ORDER PROCEDURES**

- A. Subsequent to the Owner's approval of a Proposal Request, the Contractor may proceed with the Work contained in that request. The Architect will issue a Change Order for signatures of the Owner and Contractor, as provided in the conditions of the Contract.
- B. Change Order Form: Sample copy of form included in Contract Forms Section.

**PART 2 – PRODUCTS (NOT APPLICABLE)**

**PART 3 – EXECUTION (NOT APPLICABLE)**

**END OF SECTION**

**SECTION 010400  
PROJECT COORDINATION**

**PART 1 – GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to Work of this Section.

**1.02 SUMMARY**

- A. This Section specifies requirements necessary for Project Coordination including, but not limited to:
  1. Coordination.
  2. General installation provisions.
  3. Cleaning and protection.

**1.03 COORDINATION**

- A. Coordination: Coordinate and schedule construction activities included in Sections of Specifications to assure efficient and orderly installation of the Work. Coordinate construction included under Sections of the Specifications that are dependent upon each other for proper installation, connection and operation.

**PART 2 – PRODUCTS (NOT APPLICABLE)**

**PART 3 – EXECUTION**

**3.01 GENERAL INSTALLATION PROVISIONS**

- A. Inspection of Conditions: The Installer of each major component is to inspect the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.
- B. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations unless more stringent requirements are specified.
- C. Inspect materials or equipment upon delivery and prior to installation. Reject damaged and defective items.
- D. Provided attachment and connection devices and methods necessary for securing Work. Secure Work true to line and level. Allow for expansion and building movement.
- E. Visual Effects: Provide uniform joint widths in exposed Work. Arrange joints in exposed Work to obtain the best visual effect. Refer questionable choices to the Architect for final decision.
- F. Recheck measurements and dimensions, before starting each installation.

**3.02 CLEANING AND PROTECTION**

- A. During handling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure protection from damage or deterioration.
- B. Clean and maintain completed construction and construction area through the construction period.

**END OF SECTION**



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**SECTION 010450  
CUTTING AND PATCHING**

**PART 1 – GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to Work of this Section.

**1.02 SUMMARY**

- A. This Section includes administrative and procedural requirements for cutting and patching.

**1.03 RELATED SECTIONS: THE FOLLOWING SECTIONS CONTAIN REQUIREMENTS THAT RELATE TO THIS SECTION.**

- A. Division 1 Section “Project Coordination” details procedures for coordinating cutting and patching with other construction activities.
- B. Division 2 Section “Selective Demolition” details demolition of selected portions of the building for alterations.
- C. Refer to other Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
  - 1. Requirements of this Section apply to mechanical and electrical installations. Refer to Division 15 and Division 16 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

**1.04 SUBMITTALS**

- A. Cutting and Patching Proposal: Submit a Proposal describing procedures well in advance of the time cutting and patching will be performed if the Owner requires approval of these procedures before proceeding. Request approval to proceed. Include the following information, as applicable, in the Proposal.
  - 1. Describe the extent of cutting and patching required. Show how it will be performed and indicate why it cannot be avoided.
  - 2. Describe anticipated results in terms of changes to existing construction. Include changes to structural elements and operating components as well as changes in the building’s appearance and the other significant visual elements.
  - 3. List products to be used and firms or entities that will perform Work.
  - 4. Indicate dates when cutting and patching will be performed.
  - 5. Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out-of-service. Indicate how long service will be disrupted.
  - 6. When cutting and patching involves adding reinforcement to structural elements, submit detail and engineering calculations showing integration of reinforcement with the original structure.
  - 7. Approval by the Architect to proceed with cutting and patching does not waive the Architect’s right to later require complete removal and replacement of unsatisfactory Work.

**1.05 QUALITY ASSURANCE**

- A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would change their load carrying capacity or load deflection ratio.
  - 1. Obtain approval of the cutting and patching Proposal before cutting and patching the following structural elements:
    - a. Foundation construction.
    - b. Bearing and retaining walls.
    - c. Structural concrete.
    - d. Structural steel.

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- e. Lintels.
- f. Timber and primary wood framing.
- g. Structural decking.
- h. Stair systems.
- i. Miscellaneous structural metals.
- j. Exterior curtain wall construction.
- k. Equipment supports.
- l. Piping, ductwork, vessels and equipment.
- m. Structural systems of special construction in Division 13 Sections.

**1.06 OPERATIONAL LIMITATIONS: DO NOT CUT AND PATCH OPERATING ELEMENTS OR RELATED COMPONENTS IN A MANNER THAT WOULD RESULT IN REDUCING THEIR CAPACITY TO PERFORM AS INTENDED. DO NOT CUT AND PATCH OPERATING ELEMENTS OR RELATED COMPONENTS IN A MANNER THAT WOULD RESULT IN INCREASED MAINTENANCE OR DECREASED OPERATION LIFE OR SAFETY.**

- A. Obtain approval of the cutting and patching Proposal before cutting and patching the following operating elements or safety related systems:
  - 1. Primary operational systems and equipment.
  - 2. Air or smoke barriers.
  - 3. Water, moisture or vapor barriers.
  - 4. Membranes and flashings.
  - 5. Fire protection systems.
  - 6. Noise and vibration control elements and systems.
  - 7. Control systems.
  - 8. Communication systems.
  - 9. Conveying systems.
  - 10. Electrical wiring systems.
  - 11. Operating systems of special construction in Division 13 Sections.

**1.07 VISUAL REQUIREMENTS: DO NOT CUT AND PATCH CONSTRUCTION EXPOSED ON THE EXTERIOR OR IN OCCUPIED SPACES IN A MANNER THAT WOULD, IN THE ARCHITECT'S OPINION, REDUCE THE BUILDINGS AESTHETIC QUALITIES. DO NOT CUT AND PATCH CONSTRUCTION IN A MANNER THAT WOULD RESULT IN VISUAL EVIDENCE OF CUTTING AND PATCHING. REMOVE AND REPLACE CONSTRUCTION CUT AND PATCHED IN A VISUALLY UNSATISFACTORY MANNER.**

- A. If possible, retain the original Installer or Fabricator to cut and patch the exposed Work listed below. If it is impossible to engage the original Installer or Fabricator, engage another recognized, experienced and specialized firm.
  - 1. Processed concrete finishes.
  - 2. Stonework and stone masonry.
  - 3. Ornamental metal.
  - 4. Matched veneer woodwork.
  - 5. Preformed metal panels.
  - 6. Fire stopping.
  - 7. Window wall system.
  - 8. Stucco and ornamental plaster.
  - 9. Acoustical ceilings.
  - 10. Terrazzo.
  - 11. Finished wood flooring.
  - 12. Fluid applied flooring.
  - 13. Carpeting.
  - 14. Aggregate wall coating.

15. Wall covering.
16. Swimming pool finishes.
17. HVAC enclosures, cabinets or covers.

#### **1.08 WARRANTY**

- A. Existing Warranties: Replace, patch and repair material and surfaces cut or damaged by methods and with materials in such a manner as not to void any warranties required or existing.

### **PART 2 – PRODUCTS**

#### **2.01 MATERIALS**

- A. General: Use materials identical to existing materials. For exposed surfaces use materials that visually match existing adjacent surfaces to the fullest extent possible if identical materials are unavailable or cannot be used. Use materials whose installed performance will equal or surpass that of existing materials.

### **PART 3 – EXECUTION**

#### **3.01 INSPECTION**

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed before cutting. If unsafe or unsatisfactory conditions are encountered, take corrective action before proceeding.
  1. Before proceeding, meet at the Project Site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

#### **3.02 PREPARATION**

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching.
- C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Avoid cutting existing pipe, conduit, or ductwork serving the building but scheduled to be removed or relocated until provisions have been made to bypass them.

#### **3.03 PERFORMANCE**

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.
  1. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.
- B. Cutting: Cut existing construction using methods least likely to damage elements retained or adjoining construction.
  1. In general, where cutting, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
  3. Cut through concrete and masonry using a cutting machine, such as a Carborundum Saw or a Diamond Core Drill.
  4. Comply with requirements of applicable Division 2 Sections where cutting and patching requires excavating and backfilling.

5. Where services are required to be removed, relocated, or abandoned, bypass utility services, such as pipe or conduit, before cutting. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after bypassing and cutting.

**3.04 PATCHING: PATCH WITH DURABLE SEAMS THAT ARE AS INVISIBLE AS POSSIBLE.  
COMPLY WITH SPECIFIED TOLERANCES.**

- A. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
- B. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
- C. Where removing walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
- D. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing the patch after the area has received primer and second coat.
- E. Patch, repair, or rehang existing ceilings as necessary to provide an even plane surface of uniform appearance.

**3.05 CLEANING**

- A. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty and similar items. Thoroughly clean piping, conduit and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

**END OF SECTION**

**SECTION 010500  
FIELD ENGINEERING**

**PART 1 – GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to Work of this Section.

**1.02 SUMMARY**

- A. General: This Section specifies administrative and procedural requirements for field engineering services including, but not limited the following:
  - 1. Layout Work.

**1.03 SUBMITTALS**

- A. Project Record Documents: Submit a record of Work performed and record survey data as required under provisions of Division 1 “Submittals” and “Project Close Out” Sections.

**PART 2 – PRODUCTS (NOT APPLICABLE)**

**PART 3 – EXECUTION**

**3.01 EXAMINATION**

- A. Verify layout information shown on the Drawings, in relation to the existing building and existing benchmarks, before proceeding to layout the Work. Locate and protect existing benchmarks and control points. Preserve permanent reference points during construction.
- B. Establish and maintain a minimum of two (2) permanent benchmarks on the Site, referenced to data established by survey control points.
  - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
- C. Existing Utilities and Equipment: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning Site Work, investigate and verify the existence and location of underground utilities and other construction.
  - 1. Prior to construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water service piping.

**3.02 PERFORMANCE**

- A. Establish benchmarks and marks to set lines and levels at each story of construction and elsewhere as needed to locate each element of the Project. Calculate and measure required dimensions within indicated or recognized tolerances. Do not scale Drawings to determine dimensions.
  - 1. Advise entities engaged in construction activities of marked lines and levels provided for their use.
  - 2. As construction proceeds, check every major element for line, level and plumb.
- B. Site Improvements: Locate and layout Site improvements, including pavement, stakes for grading, fill and topsoil placement, utility slopes and invert elevations.
- C. Building Lines and Levels: Locate and layout batter boards for structures, building foundations, column grids and locations, floor levels, control lines and levels required for mechanical and electrical Work.
- D. Existing Utilities: Furnish information necessary to adjust, move or relocate existing structures, utility poles, lines, services or other appurtenances located in or affected by construction. Coordinate with local authorities having jurisdiction.

**END OF SECTION**

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**SECTION 010950**  
**REFERENCE STANDARDS & DEFINITION**

**PART 1 – GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to Work of this Section.

**1.02 DEFINITIONS**

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. Approve: The term “approved”, where used in conjunction with the Architect’s action on the Contractor’s submittals, applications, and requests, is limited to the Architect’s duties and responsibilities as stated in the Conditions of the Contract.
- C. Back Prime: See “Prime”.
- D. Directed: Terms such as “directed”, “requested”, and “authorized” mean “directed by the Architect”, “requested by the Architect” and similar phrases.
- E. Furnish: The term “furnish” is used to mean “supply and deliver to the Project Site, ready for unloading, unpacking, assembly, installation and similar operations”.
- F. Indicated: The term “indicated” means “indicated by Contract Documents.” Where terms such as “shown”, “noted”, “scheduled” and “specified” are used, it is to help the reader locate the reference; no limitation on location is intended.
- G. Install: The term “install” is used to describe operations at the Project Site including the actual unloading, unpacking, assembly, erection, placing anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations.
- H. Regulation: The term “regulation” includes laws, ordinances, statutes and lawful orders issued by authorities having jurisdiction, as well as rules, conventions and agreements within the construction industry that control performance of the Work.
- I. Prime: The term “prime” means that first layer of finishing and means all edges, ends and surfaces, unless otherwise indicated.
- J. Project Site: The term “Project Site” refers to the space available to the Contractor for performance of construction activities, as part of the Project. The extent of the Project Site is shown on the Drawings.
- K. Provide: The term “provide” means “to furnish and install, complete and ready for the intended use”.

**1.03 INDUSTRY STANDARDS**

- A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with the standard in effect as of the date of the Contract Documents.
- C. Copies of Standards: Copies of applicable standards are not bound with the Contract Documents.
  - 1. Where copies of standards are needed for performance of a required construction activity, the Contractor shall obtain copies directly from the publication source.
- D. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association,



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standards generating organization, authority having jurisdiction, or other entity applicable to the context of the provision. Refer to the "Encyclopedia of Associations", published by Gale Research Company, available in most libraries.

**1.04 GOVERNING REGULATIONS/AUTHORITIES**

- A. The Architect has contacted authorities having jurisdiction where necessary to obtain information necessary for preparation of Contract Documents. Contact authorities having jurisdiction directly for information and decisions having a bearing on the Work.
- B. All buildings, construction Work and all mechanical installation and appliances connected therewith shall comply with all State and Municipal Laws and Regulations and with all local ordinances and rules, pertaining to this Work. Such laws, regulations, ordinances and rules shall be considered to be a part of these Specifications. Attention is directed to the current OSHA Standards. All equipment, tools and materials which are furnished and/or installed as part of this Contract shall meet or exceed the aforementioned standards in order to be considered.

**1.05 SUBMITTALS**

- A. Permits, Licenses and Certificates: For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases and similar documents and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work.

**PART 2 – PRODUCTS (NOT APPLICABLE)**

**PART 3 – EXECUTION (NOT APPLICABLE)**

**END OF SECTION**

**SECTION 011000  
SUMMARY**

**PART 1 GENERAL**

**1.01 PROJECT**

- A. Project Name: North Bend VA CBOC
- B. The Project consists of the tenant finish to an existing single story building, to create a remodel of an outpatient treatment clinic for the VA. Building renovations include new interior walls, interior finishes, new electrical, mechanical, plumbing systems, new security system, RTUs and other related construction.

**1.02 CONTRACT DESCRIPTION**

- A. Contract Type: A single prime contract based on a Stipulated Price as described in Document 005200 - Agreement Form.

**1.03 DESCRIPTION OF ALTERATIONS WORK**

- A. Scope of alterations work is indicated on drawings.

**1.04 WORK BY OWNER**

**1.05 OWNER OCCUPANCY**

- A. Owner intends to continue to occupy adjacent portions of the existing building during the entire construction period.
- B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- C. Schedule the Work to accommodate Owner occupancy.

**1.06 CONTRACTOR USE OF SITE AND PREMISES**

- A. Construction Operations: Limited to areas noted on Drawings.
  - 1. Locate and conduct construction activities in ways that will limit disturbance to site.
- B. Provide access to and from site as required by law and by Owner:
  - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
  - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.

**END OF SECTION**

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**SECTION 011400  
WORK RESTRICTIONS**

**PART 1 – GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to Work of this Section.

**1.02 USE OF PREMISES**

- A. Use of Site: Limit use of premises to Work in areas indicated. Do not disturb portions of Site beyond areas in which the Work is indicated.
  - 1. Limits: Confine constructions operations to area indicated on Drawings.
  - 2. Owner Occupancy: Allow for Owner building occupancy use of Site and for use by the public.
  - 3. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to the Owner, Owner's employees and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
    - a. Schedule deliveries to minimize use of driveways and entrances.
    - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on Site.
- B. Use of Existing Building: Maintain existing building in a weather tight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.

**1.03 OCCUPANCY REQUIREMENTS**

- A. Full Owner Occupancy: Owner will occupy Site and existing building during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations.

**PART 2 – PRODUCTS (NOT APPLICABLE)**

**PART 3 – EXECUTION (NOT APPLICABLE)**

**END OF SECTION**

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**SECTION 012000  
PROJECT MEETINGS**

**PART 1 – GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to Work of this Section.

**1.02 SUMMARY**

- A. This Section specifies requirements for Project Meetings including but not limited to:
  - 1. Pre-Construction Conference.
  - 2. Progress Meetings.
- B. Construction Schedules are specified in Division 1 “Submittals” Section.

**1.03 PRE-BID CONFERENCE**

- A. Pre-Bid Conference to be held at \_\_ (time) \_\_ am/pm, \_\_ (day) \_\_, \_\_ (date) \_\_, at the Job Site, \_\_ (address) \_\_\_\_\_.
- B. The Pre-Bid Conference is mandatory.

**1.04 PRE-CONSTRUCTION CONFERENCE**

- A. Schedule a pre-construction meeting no later than ten (10) days after execution of the Contract and prior to commencement of construction activities. Conduct the meeting to review responsibilities and personnel assignments.
- B. Attendee: The Owner, Architect and their consultants, the Contractor and its Superintendent, major subcontractors and other concerned parties.
- C. Agenda: Discuss items of significance which could affect progress including such topics as the following:
  - 1. Tentative Construction Schedule.
  - 2. Critical Work sequencing.
  - 3. Designation of responsible personnel.
  - 4. Procedures for processing field decisions and Change Orders.
  - 5. Procedures for processing Applications for Payment.
  - 6. Distribution of Contract Documents.
  - 7. Submittal of Shop Drawings, product data, and samples.
  - 8. Preparation of record documents.
  - 9. Use of the premises.
  - 10. Safety procedures.
  - 11. First aid.
  - 12. Security.
  - 13. Housekeeping.

**1.05 PROGRESS MEETINGS**

- A. Conduct progress meetings at the Project Site at two (2) week intervals. Notify the concerned parties of meeting dates.
- B. Attendees: Owner and Architect, Contractor or Contractor’s Superintendent, each subcontractor, supplier or any other entity concerned with current or future activities.
- C. Agenda: Minutes of the previous progress meeting. Review items that could affect progress and topics appropriate to the current status of the Project.
- D. Contractor’s Construction Schedule: Review progress since the last meeting. Expedite items behind schedule. Review the present and future needs of each entity present.

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- E. Schedule Updating: Revise the Construction Schedule after each progress meeting where revisions to the schedule have been made. Issue the revised schedule with the report of each meeting.

**PART 2 – PRODUCTS (NOT APPLICABLE)**

**PART 3 – EXECUTION (NOT APPLICABLE)**

**END OF SECTION**

**SECTION 013000  
SUBMITTALS**

**PART 1 – GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to Work of this Section.

**1.02 SUMMARY**

- A. Section includes administrative and procedural requirements for submitting Contractor's Construction Schedule, Shop Drawings, Product Data, Samples, and other Submittals.

**1.03 RELATED SECTIONS:**

- A. Division 1 Section "Application for Payment" for submitting Applications for Payment and the Schedule of Values.
- B. Division 1 Section "Project Closeout" for submitting record Drawings and Maintenance Manuals.

**1.04 DEFINITIONS**

- A. Submittals: Written and graphic information and physical samples that require Architect's responsive action. Required submittals are indicated in individual Specification Sections.
- B. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

**1.05 SUBMITTAL ADMINISTRATIVE REQUIREMENTS**

- A. All Submittals to be electronic.
- B. Architect's Digital Data Files: Electronic copies of CAD Drawings of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.
  - 1. Architect will furnish Contractor with one set of digital drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.
    - a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract drawings.
    - b. Digital Drawing Software Program: The Contract Drawings are available AutoCad 2014.
    - c. The following plot files will be furnished for each appropriate discipline:
      - 1) Floor plans
      - 2) Reflected ceiling plans
      - 3) Other files as approved by the Architect
- C. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
  - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  - 2. Coordinate transmittal of different types of submittals for related parts of the work so processing will not be delayed because of need to review submittals concurrently for coordination.
- D. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the work to permit processing, including resubmittals.
  - 1. Initial Review: Allow 10 working days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required.



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2. Resubmittal Review: Allow 10 working days for review of each resubmittal.
- E. Identification and Information: Identify and incorporate information in each electronic submittal file as follows:
  1. Assemble complete submittal package into a single indexed file with links enabling navigation of each item.
  2. Name file with submittal number or other unique identifier, including revision identifier.
    - a. File name shall use project name and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-06100.01).
- F. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
- G. Include the following information on an inserted cover sheet:
  1. Project name
  2. Date
  3. Name and address of Architect
  4. Name of Contractor
  5. Name, address and phone number of entity involved
  6. Number and title of appropriate Specification Section
  7. Drawing number and detail references, as appropriate
  8. Related physical samples submitted directly
- H. Options: Identify options requiring selection by the Architect.
- I. Deviations: Identify deviations from the Contract Documents on submittals.
- J. Transmittal: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without Contractor's review, or submittals received from sources other than Contractor.
  1. Transmittal Form: Provide locations on form for the following information:
    - a. Project name
    - b. Date
    - c. Destination (To:)
    - d. Source (From:)
    - e. Names of subcontractor, manufacturer and supplier
    - f. Submittal purpose and description
    - g. Specification Section number and title
    - h. Drawing number and detail references, as appropriate
    - i. Transmittal number (numbered consecutively)
    - j. Remarks
- K. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, and deviations from requirements in the Contract Documents.
- L. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
  1. Note date and content of previous submittal.
  2. Note data and content of revision in label or title block and clearly indicate extent of revision.
  3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- M. Use for Construction: Use only final submittals that are marked with approval notation from Architect's action stamp.

## **PART 2 – PRODUCTS**

### **2.01 SUBMITTAL PROCEDURES**

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
  - 1. Communications are to be type written, absolutely no handwritten communications will be accepted.
  - 2. Submit electronic submittals via email as PDF electronic files.
    - a. Architect will return annotated file. Annotate and retain on copy of file as an electronic Project record document file.
  - 3. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 1 Section “Project Closeout.”
  - 4. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
    - a. Provide a digital signature on electronically submitted certificates and certifications.
  - 5. Test and Inspection Submittals: Comply with requirements specified in Division 1 Section “Quality Control.”
  - 6. Contractors will submit Submittals within two (2) weeks of execution of subcontract.

### **2.02 CONTRACTOR’S CONSTRUCTION SCHEDULE**

- A. Bar Chart Schedule: Prepare a fully developed, horizontal bar chart type Contractor’s Construction Schedule. Submit within fifteen (15) days of execution of the Contract.
  - 1. Prepare the schedule on a sheet, or other reproducible media, of sufficient width to show data for the entire construction period.
  - 2. Secure time commitments for performing critical elements of the Work from parties involved. Show each activity in proper sequence. Indicate graphically sequences necessary for completion of related portions of the Work.
  - 3. Indicate Substantial Completion on the schedule to allow time for the Architect’s procedures necessary for certification of Substantial Completion.
- B. Distribution: Following response to the initial Submittal, print and distribute copies to the Architect, Owner, subcontractors and other parties required to comply with the scheduled dates. Post copies in the temporary field office.
  - 1. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.
- C. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
  - 1. Mark each copy of each submittal to show which products and options are applicable.
  - 2. Include the following information, as applicable:
    - a. Manufacturer’s catalog cuts.
    - b. Manufacturer’s product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
    - g. Notation of coordination requirements.
    - h. Availability and delivery time information.
  - 3. For equipment, include the following in addition to the above, as applicable:
    - a. Wiring diagrams showing factory-installed wiring.
    - b. Printed performance curves.

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- c. Operational range diagrams.
    - d. Drawings.
  - 4. Submit Product Data before or concurrent with Samples.
  - 5. Submit Product Data in the following format:
    - a. PDF electronic file.
- D. Shop Drawings: Prepare project specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
  - 1. Preparation: Include the following information, as applicable:
    - a. Identification of products and materials.
    - b. Compliance with specified standards.
    - c. Notation of coordination requirements.
    - d. Notation of dimensions established by field measurement.
    - e. Relationship and attachment to adjoining construction clearly indicated.
    - f. Seal and signature of professional engineer if required.
  - 2. Sheet size: Except for templates, patterns and similar full-size drawings, submit Shop Drawings in sheets at least 8-1/2 by 11 inches but no larger than 24 by 36 inches.
  - 3. Submit Shop Drawings in the following format:
    - a. PDF electronic file.
  - 4. Shop Drawings will be submitted within two (2) weeks of execution of subcontract.
- E. Samples: Submit Samples for review of kind, color, pattern and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
  - 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
  - 2. Identification: Attach label on unexposed side of Samples that includes the following:
    - a. Generic description of Sample.
    - b. Product name and name of manufacturer.
    - c. Sample source.
    - d. Number and title of applicable Specification Section.
- F. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity.
- G. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures and patterns available.
  - 1. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
- H. Samples for verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected.
  - 1. Number of Samples: Submit three sets of Samples. Architect will retain two sample sets; remainder will be returned.
    - a. Submit a single Sample where assembly details, workmanship fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
    - b. If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- I. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact

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information of architects and owners, and other information specified.

- J. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on American Welding Society (AWS) forms. Include names of firms and personnel certified.
- K. Installer Certificates: Submit written statements on manufacturer's letter head certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for the specific Project.
- L. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- M. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- N. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- O. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- P. Product Test Reports: Submit written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

### **2.03 DELEGATED DESIGN SERVICES**

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file and two paper copies of certificate, signed and sealed by a design professional.
  - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

## **PART 3 – EXECUTION**

### **3.01 CONTRACTOR'S REVIEW**

- A. Submittals: Review each submittal and check for coordination with other work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Project Closeout and Maintenance/Material Submittals: Refer to requirements in Division 1 Section 'Closeout Procedures.'
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked and approved for compliance with the Contract Documents.

**3.02 ARCHITECT'S ACTION**

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Submittals: Architect will review each submittal, make marks to indicate corrections of modifications required, and return it. Architect will stamp each submittal with an action stamp and will stamp appropriately to indicate action, as follows:
  - 1. No Exceptions
  - 2. Revise and Resubmit
  - 3. Make Corrections Noted
  - 4. Rejected
  - 5. Submit Specified Item
- C. Incomplete submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- D. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

**END OF SECTION**

**SECTION 014000  
QUALITY CONTROL**

**PART 1 – GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to Work of this Section.

**1.02 SUMMARY**

**1.03 THIS SECTION INCLUDES ADMINISTRATIVE AND PROCEDURAL REQUIREMENTS FOR QUALITY CONTROL SERVICES.**

- A. Quality control services include inspections, tests, and related actions, including reports performed by Contractor, by independent agencies, and by governing authorities. They do not include Contract enforcement activities performed by Architect.
- B. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with Contract Document requirements.
- C. Requirements of this Section relate to customized fabrication and installation procedures, not production of standard products.
  - 1. Specific quality control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
  - 2. Specified inspections, tests and related actions do not limit Contractor's quality control procedures that facilitate compliance with Contract Document requirements.
  - 3. Requirements for Contractor to provide quality control services required by Architect, Owner or inspecting agency are not limited by provisions of this Section.
- D. Related Sections: The following Sections contain requirements that relate to this Section.
  - 1. Division 1 Section "Cutting and Patching" specifies requirements for repair and restoration of construction disturbed by inspection and testing activities.

**1.04 RESPONSIBILITIES**

- A. Contractor Responsibilities: Unless otherwise indicated as the responsibility of another identified entity, Contractor shall provide inspections, tests and other quality control services specified elsewhere in the Contract Documents and required by authorities having jurisdiction. Cost for these services are included in the Contract Sum.
- B. Where individual Sections specifically indicate that certain inspections, test and other quality control services are the Contractor's responsibility, the Contractor shall employ and pay a qualified independent testing agency to perform quality control services. Costs for these services are included in the Contract Sum.
- C. Where individual Sections specifically indicate that certain inspections, tests, and other quality control services are the Owner's responsibility, the Owner will employ and pay a qualified independent testing agency to perform those services.
- D. Retesting: The Contractor is responsible for retesting where results of inspections, tests, or other quality control services prove unsatisfactory and indicate noncompliance with Contract Document requirements, regardless of whether the original test was Contractor's responsibility.
  - 1. The cost of retesting construction, revised or replaced by the Contractor, is the Contractor's responsibility where required tests performed on original construction indicated noncompliance with Contract Documents.
- E. Associated Services: Cooperate with agencies performing required inspections, tests, similar services and provide reasonable auxiliary services as requested. Notify the agency sufficiently

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in advance of operations to permit assignment of personnel. Auxiliary services required include, but are not limited to the following:

1. Provide access to the Work.
  2. Furnish incidental labor and facilities necessary to facilitate inspections and tests.
  3. Take adequate quantities of representative samples of materials that require testing or assist the agency in taking samples.
  4. Provide facilities for storage and curing of test samples.
  5. Deliver samples to testing laboratories.
  6. Provide the agency with a preliminary design mix proposed for use for materials mixes that require control by the testing agency.
  7. Provide security and protection of samples and test equipment at the Project Site.
- F. Duties of the Testing Agency: The independent agency engaged to perform inspections, sampling, and testing of materials and construction specified in individual Section shall cooperate with the Architect and the Contractor in performance of the agency's duties. The testing agency shall provide qualified personnel to perform required inspections and tests.
1. The agency shall notify the Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  2. The agency is not authorized to release, revoke, alter or enlarge requirements of the Contract Documents or approve or accept any portion of the Work.
  3. The agency shall not perform any duties of the Contractor.

**1.05 COORDINATION: COORDINATE THE SEQUENCE OF ACTIVITIES TO ACCOMMODATE REQUIRED SERVICES WITH A MINIMUM OF DELAY. COORDINATE ACTIVITIES TO AVOID THE NECESSITY OF REMOVING AND REPLACING CONSTRUCTION TO ACCOMMODATE INSPECTIONS AND TESTS.**

1. The Contractor is responsible for scheduling times for inspections, tests, taking samples and similar activities.

**1.06 SUBMITTALS**

- A. The independent testing agency shall submit a certified written report, in duplicate, of each inspection, test or similar service to the Architect and the Contractor.
1. Report Data: Written reports of each inspection, test or similar service include, but are not limited to, the following:
    - a. Date of issue.
    - b. Project title and number.
    - c. Name, address and telephone number of testing agency.
    - d. Dates and locations of samples and tests or inspections.
    - e. Names of individuals making the inspection or test.
    - f. Designation of the Work and test method.
    - g. Identification of product and Specification Section.
    - h. Complete inspection or test data.
    - i. Test results and an interpretation of test results.
    - j. Ambient conditions at the time of sample taking and testing.
    - k. Comments or professional opinion on whether inspected or tested Work complies with Contract Document requirements.
    - l. Name and signature of laboratory inspector.
    - m. Recommendations on retesting.

**1.07 QUALITY ASSURANCE**

- A. Qualifications for Service Agencies: Engage inspection and testing service agencies, including independent testing laboratories, which are prequalified as complying with the American Council of Independent Laboratories, "Recommended Requirements for Independent Laboratory Qualification" and that specialize in the types of inspections and tests to be

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performed.

**PART 2 – PRODUCTS (NOT APPLICABLE)**

**PART 3 – EXECUTION**

**3.01 REPAIR AND PROTECTION**

- A. General: Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and restore substrates and finishes. Comply with Contract Document requirements for Division 1 Section "Cutting and Patching."
- B. Protect construction exposed by or for quality control service activities, and protect repaired construction.
- C. Repair and protection is Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing or similar services.

**END OF SECTION**



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**SECTION 015000  
TEMPORARY FACILITIES**

**PART 1 – GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to Work of this Section.

**1.02 SUMMARY**

- A. This Section specifies requirements for temporary services and facilities; including utilities, construction and support facilities, security and protection.

**1.03 QUALITY ASSURANCE**

- A. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction, including but not limited to:
  - 1. Building Code requirements.
  - 2. Health and safety regulations.
  - 3. Utility company regulations.
  - 4. Environmental protection regulations.
- B. Standards: Comply with NFPA Code 241, "Building Construction and Demolition Operations," ANSI-A10 Series standard for "Safety Requirements for Construction and Demolition," and NECA Electrical Design Library "Temporary Electrical Facilities."
- C. Electrical Service: Comply with NEMA, NECA and UL standards and regulations for temporary electrical service. Install service in compliance with NFPA 70, National Electric Code.

**1.04 PROJECT CONDITIONS**

- A. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities or permit them to interfere with progress. Do not allow hazardous, dangerous and unsanitary conditions or public nuisances to develop or persist on the Site.

**PART 2 – PRODUCTS**

**2.01 MATERIALS**

- A. General: Provide materials suitable for the use intended.
- B. Lumber and Plywood: Comply with requirements in Division 6 Section "Rough Carpentry."

**2.02 EQUIPMENT**

- A. Water Hoses: Provided  $\frac{3}{4}$ " heavy duty, abrasion resistant, flexible rubber hoses of length required, with pressure rating greater than the maximum pressure of the water distribution system. Provide adjustable shut off nozzles at hose discharge.
- B. Electrical Power Cords: Provide grounded extension cords; use "hard service" cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas where construction activities are in progress.
- C. Lamps and Light Fixtures: Provide general service lamps of wattage required for adequate illumination. Provide guard cages or tempered glass enclosures, where exposed to breakage. Provide exterior fixtures where areas are exposed to moisture.
- D. Heating Units: Provide temporary heating units that have been tested and labeled by UL, FM or another recognized trade association related to the type of fuel being consumed.
- E. First Aid Supplies: Comply with governing regulations.
- F. Fire Extinguishers: Provide hand carried, portable UL rated, class "A" fire extinguisher for temporary offices and similar spaces.

1. For other locations, comply with NFPA 10 and 241 for classification, extinguishing agent and size required by location and class of fire exposure.

### **PART 3 – EXECUTION**

#### **3.01 UTILITIES**

- A. General: Engage the appropriate local utility company to install temporary service. Where the company provides only part of the service, provide the remainder with matching, compatible materials and equipment; comply with the utilities recommendations.
  1. Arrange with the company and existing users for a time when service can be interrupted, where necessary, to make connections for temporary services.
  2. Provide adequate capacity at each stage of construction.
- B. Use Charges: Cost or use charges for temporary facilities are not chargeable to the Owner or Architect and will not be accepted as a basis of claims for a Change Order.
- C. Water Service: Contractor shall provide temporary water service as required. Contractor to provide all hoses, hookups, etc.
  1. Sterilization: Sterilize temporary water piping prior to use.
- D. Electric Power Service: Contractor shall provide temporary electrical service as required. Contractor to provide all hookups, cords, panels, etc.
- E. Temporary Lighting: Provide temporary lighting with local switching.
  1. Install and operate temporary lighting that will fulfil security and protection requirements, without operating the entire system, and will provide adequate illumination for construction operations and traffic conditions.
- F. Temporary Telephones: Provide cellular phone service or a temporary non coin box telephone service for all personnel engaged in construction activities, throughout the construction period. Install immediately after start of Work, maintain until Project completion. Notify Architect of telephone number. Allow all connected with the Work to use telephone, provided they pay for toll calls. Telephone to have outside bell.

#### **3.02 TEMPORARY CONSTRUCTION AND SUPPORT FACILITIES INSTALLATION**

- A. Temporary Heat: Provide temporary heat as required by construction activities, for curing or drying of completed installations or protection of installed construction from adverse effects of low temperatures or high humidity.

#### **3.03 HEATING FACILITIES: EXCEPT WHERE USE OF THE PERMANENT SYSTEM IS AUTHORIZED, PROVIDE VENTED SELF-CONTAINED LP GAS OR FUEL OIL HEATERS WITH INDIVIDUAL SPACE THERMOSTATIC CONTROL.**

1. Use of gasoline burning space heaters, open flame or salamander type heating units are prohibited.
- B. Toilets: Temporary toilet facilities will be provided by Contractor. Remove from Project Site after Project is accepted as substantially complete.
  1. Provide toilet tissue, paper towels, paper cups and similar disposal materials for each facility.
  2. Provide covered waste containers for used materials.
- C. Dewatering Facilities and Drains: For temporary drainage and dewatering facilities and operations not directly associated with construction activities included under individual Sections, comply with dewatering requirements of applicable Division 2 Sections. Where feasible, utilize the same facilities. Maintain the site, excavations and construction free of water.
- D. Temporary Enclosures: Provide temporary enclosure for protection of construction in progress and completed, from exposure, foul weather, other construction operations and similar activities.

- E. Collection and Disposal of Waste: Collect waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Dispose of material in a lawful manner.

### **3.04 MOISTURE AND MOLD CONTROL**

- A. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
  1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
  2. Keep interior spaces reasonably clean and protected from water damage.
  3. Periodically collect and remove waste containing cellulose or other organic material.
  4. Discard or replace water damaged material.
  5. Do not install material that is wet.
  6. Discard, replace or clean stored or installed material that begins to grow mold.
  7. Perform Work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

### **3.05 SECURITY AND PROTECTION FACILITIES INSTALLATION**

- A. Except for use of permanent fire protection as soon as available, do not change over from use of temporary security and protection facilities to permanent facilities until Substantial Completion.
- B. Temporary Fire Protection: Until fire protection needs are supplied by permanent facilities, install and maintain temporary fire protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 10 "Standard for Portable Fire Extinguishers," and NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition Operations."
  1. Locate fire extinguishers where convenient and effective for the intended purpose.
  2. Store combustible materials in containers in fire safe locations.
  3. Provide supervision of welding operations.
- C. Barricades, Warning Signs and Lights: Comply with standards and code requirements for barricades.
  1. Construction barricades, fences, railings and similar safety precautions in accordance with but not limited to "Oregon Administrative Rules, Chapter 437."
    - a. Neatly assemble and firmly brace.
  2. Maintain as required during construction period.
    - a. Remove barriers prior to final acceptance.
- D. Environmental Protection: Provide protection, operate temporary facilities and conduct construction that comply with environmental regulations. Avoid use of tools and equipment which produce harmful noise. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near the Site.

### **3.06 OPERATION, TERMINATION AND REMOVAL**

- A. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.
- B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.
  1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation and similar facilities on a 24-hour day basis where required to achieve indicated results and to avoid possibility of damage.

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- C. Termination and Removal: Unless the Architect requests it to be maintained longer, remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, or no later than Substantial Completion.
  - 1. Materials and facilities that constitute temporary facilities are property of the Contractor.
  - 2. At Substantial Completion, clean and renovate permanent facilities that have been used during the construction period, including but not limited to:
    - a. Replace air filters and clean inside of ductwork and housings.

**END OF SECTION**

**SECTION 016000**  
**MATERIALS, DELIVERY, STORAGE AND HANDLING**

**PART 1 – GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to Work of this Section.

**1.02 QUALITY ASSURANCE**

- A. Source Limitations: To the fullest extent possible, provide products of the same kind, from a single source.

**1.03 PRODUCT DELIVERY, STORAGE AND HANDLING**

**1.04 DELIVER, STORE AND HANDLE PRODUCTS IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS, USING MEANS AND METHODS THAT WILL PREVENT DAMAGE, DETERIORATION AND LOSS, INCLUDING THEFT.**

1. Deliver products to the Site in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting and installing.
2. Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure products are undamaged and properly protected.
3. Store products subject to damage by the elements above ground, under cover, in a weather tight enclosure with ventilation adequate to prevent condensation. Maintain temperature and humidity within a range required by manufacturer's instructions.

**PART 2 – PRODUCTS**

**2.01 PRODUCT SELECTION**

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and unless otherwise indicated, unused at the time of installation.
  1. Provide products complete with all accessories, trim, finish, safety guards, other devices and details needed for a complete installation and for the intended use and effect.
- B. Product Selection Procedures: Product selection is governed by the Contract Documents and governing regulations.
  1. For products specified only by reference standards, select any product meeting standards by any manufacturer.
  2. For products specified naming several products or manufacturers, select any product and/or manufacturer named.
  3. For products specified by naming one or more products but indicating the option of selecting equivalent products by stating "or equal" after specified product; the Contractor must submit requests as required for the substitution for any product not specifically named.
  4. For products specified by naming only one (1) product and manufacturer, there is no option, and no substitution will be allowed.
- C. Compliance with Standards, Codes and Regulations: Where the Specifications only require compliance with an imposed code, standard or regulation, select a product that complies with the standards, codes or regulations specified.

**PART 3 – EXECUTION**

**3.01 INSTALLATION AND PRODUCTS**

- A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other Work.

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1. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

**END OF SECTION**

**SECTION 016116  
VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Requirements for Indoor-Emissions-Restricted products.
- B. Requirements for VOC-Content-Restricted products.

**1.02 RELATED REQUIREMENTS**

- A. Section 013000 Submittals

**1.03 DEFINITIONS**

- A. Indoor-Emissions-Restricted Products: All products in the following product categories, whether specified or not:
  - 1. Interior paints and coatings applied on site.
  - 2. Interior adhesives and sealants applied on site, including flooring adhesives.
  - 3. Flooring.
  - 4. Composite wood.
  - 5. Products making up wall and ceiling assemblies.
  - 6. Thermal and acoustical insulation.
- B. VOC-Content-Restricted Products: All products in the following product categories, whether specified or not:
  - 1. Interior paints and coatings applied on site.
  - 2. Interior adhesives and sealants applied on site, including flooring adhesives.
- C. Interior of Building: Anywhere inside the exterior weather barrier.
- D. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.
- E. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.
- F. Inherently Non-Emitting Materials: Products composed wholly of minerals or metals, unless they include organic-based surface coatings, binders, or sealants; and specifically the following:
  - 1. Concrete.
  - 2. Metals that are plated, anodized, or powder-coated.
  - 3. Glass.
  - 4. Ceramics.

**1.04 REFERENCE STANDARDS**

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency current edition.
- B. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings 2005 (Reapproved 2018).
- C. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers 2017, v1.2.
- D. CARB (ATCM) - Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products; California Air Resources Board current edition.
- E. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board 2020.
- F. CHPS (HPPD) - High Performance Products Database Current Edition.
- G. CRI (GLP) - Green Label Plus Testing Program - Certified Products Current Edition.



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- H. SCAQMD 1113 - Architectural Coatings 1977, with Amendment (2016).
- I. SCAQMD 1168 - Adhesive and Sealant Applications 1989, with Amendment (2017).
- J. SCS (CPD) - SCS Certified Products Current Edition.
- K. UL (GGG) - GREENGUARD Gold Certified Products Current Edition.

#### **1.05 SUBMITTALS**

- A. See Section 013000 Substitutions for submittal procedures.
- B. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.

#### **1.06 QUALITY ASSURANCE**

- A. Indoor Emissions Standard and Test Method: CAL (CDPH SM), using Standard Private Office exposure scenario and the allowable concentrations specified in the method, and range of total VOC's after 14 days.
  - 1. Wet-Applied Products: State amount applied in mass per surface area.
  - 2. Paints and Coatings: Test tinted products, not just tinting bases.
  - 3. Evidence of Compliance: Acceptable types of evidence are the following;
    - a. Current UL (GGG) certification.
    - b. Current SCS (CPD) Floorscore certification.
    - c. Current SCS (CPD) Indoor Advantage Gold certification.
    - d. Current listing in CHPS (HPPD) as a low-emitting product.
    - e. Current CRI (GLP) certification.
    - f. Test report showing compliance and stating exposure scenario used.
  - 4. Product data submittal showing VOC content is NOT acceptable evidence.
  - 5. Manufacturer's certification without test report by independent agency is NOT acceptable evidence.
- B. VOC Content Test Method: 40 CFR 59, Subpart D (EPA Method 24), or ASTM D3960, unless otherwise indicated.
  - 1. Evidence of Compliance: Acceptable types of evidence are:
    - a. Report of laboratory testing performed in accordance with requirements.
- C. Composite Wood Emissions Standard: CARB (ATCM) for ultra-low emitting formaldehyde (ULEF) resins.
  - 1. Evidence of Compliance: Acceptable types of evidence are:
    - a. Current SCS "No Added Formaldehyde (NAF)" certification; [www.scs-certified.com](http://www.scs-certified.com).
    - b. Report of laboratory testing performed in accordance with requirements.
    - c. Published product data showing compliance with requirements.
- D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

### **PART 2 PRODUCTS**

#### **2.01 MATERIALS**

- A. All Products: Comply with the most stringent of federal, State, and local requirements, or these specifications.
- B. Indoor-Emissions-Restricted Products: Comply with Indoor Emissions Standard and Test Method, except for:
  - 1. Composite Wood, Wood Fiber, and Wood Chip Products: Comply with Composite Wood Emissions Standard or contain no added formaldehyde resins.
  - 2. Inherently Non-Emitting Materials.
- C. VOC-Content-Restricted Products: VOC content not greater than required by the following:

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1. Adhesives, Including Flooring Adhesives: SCAQMD 1168 Rule.
2. Joint Sealants: SCAQMD 1168 Rule.
3. Paints and Coatings: Each color; most stringent of the following:
  - a. 40 CFR 59, Subpart D.
  - b. SCAQMD 1113 Rule.
  - c. CARB (SCM).

**PART 3 EXECUTION**

**3.01 FIELD QUALITY CONTROL**

- A. Owner reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Owner.
- B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

**END OF SECTION**

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**SECTION 016310  
PRODUCT SUBSTITUTIONS**

**PART 1 – GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to Work of this Section.

**1.02 SUMMARY**

- A. This Section specifies requirements for handling requests for substitutions made AFTER award of the Contract. Bids MUST be made on the articles and materials named in the Specifications or approved during the Bid process. Approval of substitutions after award will be made only in exceptional cases where Contractor submits evidence, satisfactory to the Architect that through no fault of his own, specified or otherwise approved products cannot be obtained in time to avoid delay in the Work. In any case, substitutions are subject to the approval of the Architect.
- B. Substitutions BEFORE the award of Bid: Requirements are specified in “Instruction to Bidders.”
- C. Standards: Refer to Division 1 Section “Reference Standards and Definitions” for applicability of industry standards to products specified.

**1.03 REQUIREMENTS GOVERNING THE CONTRACTOR’S SELECTION OF PRODUCTS AND PRODUCT OPTIONS ARE INCLUDED UNDER DIVISION 1 SECTION “MATERIALS – DELIVERY, STORAGE AND HANDLING.”**

**1.04 DEFINITIONS**

- A. Substitutions: Requests for changes in products, materials and equipment required by Contract Documents proposed by the Contractor after award of the Contract are considered requests for “substitutions.” The following are not considered substitutions:
  - 1. Substitution requested by Bidders during the bidding period and accepted prior to award of Contract are considered as included in the Contract Documents and are not subject to requirements specified in this Section for substitutions.

**1.05 SUBSTITUTIONS**

- A. Submit three (3) copies of each request for substitution for consideration. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:
  - 1. Product data, including Drawings and descriptions of products, fabrication and installation procedures.
  - 2. Samples, where applicable or requested.
  - 3. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect.
  - 4. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
  - 5. A statement indicating the substitution’s effect on the Contractor’s Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
  - 6. Cost information on proposed substitution in comparison with specified product or method; including a proposal of the net change, if any, in the Contract Sum.
  - 7. Certification by the Contractor that the substitution proposed is equal to or better in every significant respect to that required by the Contract Documents, and that it will perform

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adequately in the application indicated.

- B. In making request for substitution, Contractor represents:
1. They will provide the same guarantee for substitution as for the product or method specified.
  2. They will coordinate installation of accepted substitution into the Work, making such changes as may be required for Work to be completed in all respects.
  3. They waive all claims for additional costs related to substitution which subsequently become apparent.
  4. Cost data is complete and includes all related costs under his Contract, but excludes:
    - a. Cost under separate Contracts and Architect's redesign.

**PART 2 – PRODUCTS (NOT APPLICABLE)**

**PART 3 – EXECUTION (NOT APPLICABLE)**

**END OF SECTION**

**SECTION 017400  
WARRANTIES**

**PART 1 – GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to Work of this Section.

**1.02 SUMMARY**

- A. This Section specifies general requirements for warranties required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.
  - 1. Refer to the General Conditions for terms of the Contractor's special warranty of workmanship and materials.
  - 2. Specific requirements for warranties for the Work and products and installations that are specified to be warranted, are included in the individual Sections of Divisions 2 through 16.
- B. Disclaimers and Limitations: Manufacturer's disclaimers and limitations and product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products.

**1.03 WARRANTY REQUIREMENTS**

- A. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
- B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
- C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefitted from use of the Work through a portion of its anticipated useful service life.
- D. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties obligations, rights or remedies.
- E. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.
- F. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification or similar commitment is required on such Work or part of the Work.

**1.04 SUBMITTALS**

- A. Submit written warranties to the Architect prior to the date certified for Substantial Completion.
  - 1. Refer to individual Sections of Divisions 2 through 16 for specific content requirements and particular requirements for submittal of special warranties.
- B. Form of Submittal: At Final Completion, compile two (2) copies of each required warranty and bond properly executed by the Contractor, Subcontractor, supplier or manufacturer. Organize the warranty documents into an orderly sequence based on the Table of Contents of the Project Manual.
- C. Bind warranties and bonds in heavy duty, commercial quality, durable, 3 ring, vinyl covered, loose leaf binders, thickness as necessary to accommodate contents, and sized to receive 8½"

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x 11" paper.

1. Identify each binder on the front and the spine with the typed or printed title, "Warranties."  
The Project title or name and the name of the Contractor.

D. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

**PART 2 – PRODUCTS (NOT APPLICABLE)**

**PART 3 – EXECUTION (NOT APPLICABLE)**

**END OF SECTION**

**SECTION 017610  
TEMPORARY PROTECTIVE COVERINGS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Temporary protective coverings for installed floors, walls, other surfaces, and equipment and fixtures.

**PART 2 PRODUCTS**

**2.01 GENERAL**

- A. Provide materials that are easily removed without damage to the surfaces covered and with the following characteristics:
  - 1. Impact resistant.
  - 2. Slip resistant.
  - 3. Flame retardant.

**PART 3 EXECUTION**

**3.01 PREPARATION**

- A. Remove dirt and debris from surfaces to be protected.

**3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Trim or overlap sheet materials to fit area to be covered.
- C. Tape seams. Avoid taping directly to finished surfaces.
- D. Stretch self-adhering film materials to completely cover surface.
- E. Install door jamb protection to full height of opening.
- F. Position corner protection 8 inches (204 mm) above finished floor to 54 inches (1372 mm) high.

**3.03 REMOVAL**

- A. Remove protective coverings prior to Date of Substantial Completion. Reuse or recycle materials if possible.

**END OF SECTION**



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**SECTION 017900  
DEMONSTRATION AND TRAINING**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. Demonstration of products and systems to be commissioned and where indicated in specific specification sections.
- B. Training of Owner personnel in operation and maintenance is required for:
  - 1. Items specified in individual product Sections.
- C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
  - 1. Items specified in individual product Sections.

**1.02 RELATED REQUIREMENTS**

- A. Section 017800 - Closeout Submittals: Operation and maintenance manuals.
- B. Other Specification Sections: Additional requirements for demonstration and training.

**1.03 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Draft Training Plans: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
  - 1. Submit to Commissioning Authority for review and inclusion in overall training plan.
  - 2. Submit not less than four weeks prior to start of training.
  - 3. Revise and resubmit until acceptable.
  - 4. Provide an overall schedule showing all training sessions.
  - 5. Include at least the following for each training session:
    - a. Identification, date, time, and duration.
    - b. Description of products and/or systems to be covered.
    - c. Name of firm and person conducting training; include qualifications.
    - d. Intended audience, such as job description.
    - e. Objectives of training and suggested methods of ensuring adequate training.
    - f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
    - g. Media to be used, such as slides, hand-outs, etc.
    - h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.
- C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
  - 1. Include applicable portion of O&M manuals.
  - 2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
  - 3. Provide one extra copy of each training manual to be included with operation and maintenance data.

**1.04 QUALITY ASSURANCE**

- A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
  - 1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
  - 2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.01 DEMONSTRATION - GENERAL**

- A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.
- B. Demonstrations conducted during Functional Testing need not be repeated unless Owner personnel training is specified.
- C. Demonstration may be combined with Owner personnel training if applicable.
- D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
  - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.
  - 2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
  - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.

**3.02 TRAINING - GENERAL**

- A. Conduct training on-site unless otherwise indicated.
- B. Owner will provide classroom and seating at no cost to Contractor.
- C. Provide training in minimum two hour segments.
- D. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.
- E. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
  - 1. The location of the O&M manuals and procedures for use and preservation; backup copies.
  - 2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
  - 3. Typical uses of the O&M manuals.
- F. Product- and System-Specific Training:
  - 1. Review the applicable O&M manuals.
  - 2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
  - 3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
  - 4. Provide hands-on training on all operational modes possible and preventive maintenance.
  - 5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
  - 6. Discuss common troubleshooting problems and solutions.
  - 7. Discuss any peculiarities of equipment installation or operation.
  - 8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
  - 9. Review recommended tools and spare parts inventory suggestions of manufacturers.
  - 10. Review spare parts and tools required to be furnished by Contractor.

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11. Review spare parts suppliers and sources and procurement procedures.
- G. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

**END OF SECTION**

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**SECTION 019113  
GENERAL COMMISSIONING REQUIREMENTS**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. Section describes work associated with commissioning of selected systems including commissioning meetings, construction checks, equipment start-up, functional testing, operations and maintenance manuals, and operator training.
- B. Work Provided Under Separate Contract: Owner's Commissioning Provider (CxP) will supervise commissioning activities and provide the following commissioning services:
  - 1. Develop commissioning plan.
  - 2. Assist Contractor to incorporate commissioning activities into Project Construction Schedule.
  - 3. Conduct commissioning meetings.
  - 4. Review project submittals.
  - 5. Develop Construction Checklists and Functional Test Plans.
  - 6. Observe Construction checks and start-up of selected equipment.
  - 7. Supervise and document functional testing.
  - 8. Prepare final commissioning report.
- C. Contractor shall provide the following services:
  - 1. Assign individuals representing Contractor and mechanical, electrical, controls, and low-voltage subcontractors as members of Commissioning Team.
  - 2. Incorporate commissioning activities in Contractor's construction schedule.
  - 3. Assist CxP in development of Construction Checklists.
  - 4. Execute Construction Checklists.
  - 5. Perform Equipment Start-up.
  - 6. Perform contractor-directed verification of automatic building and lighting controls and provide required verification documentation.
  - 7. Assist CxP in development of Functional Test Plans.
  - 8. Assist CxP with Functional Testing.
  - 9. Provide Operations and Maintenance documentation.
  - 10. Perform operator training and supervise training performed by manufacturer's representative.
  - 11. Provide submittals, product data, shop drawings, controls sequences, points list, wiring diagrams, schematics, and design documents to assist in commissioning documentation development.
- D. Contractor shall provide related services as directed, including, but not limited to:
  - 1. Access to the Work
  - 2. Incidental labor, facilities, and equipment to assist CxP in conducting commissioning activities.
  - 3. Completion of required submittals.
  - 4. Coordination of Work with activities of CxP.

**1.02 RELATED SECTIONS**

- A. 22 08 00 – Commissioning of Plumbing
- B. 23 08 00 – Commissioning of HVAC
- C. 26 08 00 – Commissioning of Electrical

### 1.03 DEFINITIONS

- A. CxP: Commissioning Provider (CxP) is the Individual responsible for supervising commissioning work.
- B. Construction Phase Commissioning Plan: Document prepared by the CxP that guides commissioning work through construction, verification, and warranty periods. The plan will include a listing of commissioning team members, systems to be commissioned, narrative description of the commissioning tasks and responsibilities, and a draft copy of the commissioning forms to be executed by the Contractor.
- C. Construction Phase: Phase of the project during which the facility is constructed and equipment is installed and started. During the Construction Phase, the Contractor completes construction checklists, performs equipment start-up, performs TAB work, submits O&M manuals, and performs control system verification. The Construction Phase generally ends at Substantial Completion.
- D. Verification Phase: Phase of the project during which functional testing and operator training is performed. The Verification Phase generally begins at Substantial Completion and ends at Final Completion.
- E. Online Commissioning System: The CxP will maintain an online commissioning system, which serves as a central location for accessing commissioning documents such as the Owner's Project Requirements, Commissioning Plan, status reports, design reviews, submittal reviews, schedules, and Issues Log. The online system provides current project information to authorized project team members through general internet access. The site URL is <https://www.swecx.com>. The Issues Log portion of the site allows for the Owner's Construction Manager, Architect, and General Contractor to provide comments, document actions, and indicate resolutions.

### 1.04 SUBMITTALS

- A. Designated Commissioning Team Representatives: Submit list of names and contact information for individuals representing Contractor and Subcontractor as members of Commissioning Team.
- B. Construction Schedule: Submit updated project construction schedule to CxP monthly. Incorporate time and duration of Commissioning activities, as provided by CxP, into the construction schedule
- C. Construction Submittals and Shop Drawings: Provide as required to perform commissioning work.
  - 1. Contractor to provide CxP a copy of the submittal log. CxP will review the log and identify submittals that are associated with equipment and systems being commissioned and required to be submitted to the CxP.
  - 2. Contractor to provide an electronic copy of each submittal or shop drawing to the Owner's Representative, including all resubmissions, required by the CxP at the same time submittals are provided to the Design Team. CxP will review submittals concurrently with the Design Team and provide review comments to the Design Team. The Design Team will consolidate review comments into a single submittal review response to be provided to the Contractor.
  - 3. Contractor to provide a copy of Design Team submittal review comments to the CxP.
- D. Engineering Data: Provide shop drawings, product data, performance data, engineering data, installation and start-up data, operation and maintenance information, schematics, wiring diagrams, programming manuals, and similar information as necessary for completion of the Work of the Section in accordance with Commissioning Schedule.
- E. Construction Checklists: Complete and submit to CxP for certification. Attach copies of all manufacturers' field or factory performance and start-up test documentation provided for

associated equipment or systems.

- F. Control Verification Reports: The Contractor shall provide complete Control Verification Reports to the CxP.
  - 1. Complete reports developed by CxP and submit to CxP for certification.
  - 2. Contractor to provide the CxP with sample point-to-point verification forms that the Contractor will use during initial start-up and verification of systems. The CxP will review the forms and provide comments as necessary to the Contractor.

#### **1.05 QUALITY ASSURANCE**

- A. Provide qualified mechanics and technicians to provide required commissioning services. Technicians shall have knowledge of the Work and experience with installation and operation of the general systems and components involved to assist in commissioning activities. Individuals shall be adequately equipped to effectively assist the CxP as necessary. Upon request, submit names and qualifications of technicians to CxP for approval.
- B. Provide qualified instructors to perform operator training. Instructor shall be knowledgeable in the specific equipment and systems involved. Upon request submit names and qualifications of technicians to CxP for approval.

#### **1.06 SEQUENCING**

- A. Schedule adequate time as determined by CxP for execution of Commissioning Plan.
- B. CxP will conduct a Commissioning Process Meeting approximately 30 days after Contractor received Notice-to-Proceed and after all subcontractors are identified.
- C. CxP will prepare a Construction Phase Commissioning Plan approximately 30 days after Commissioning Process Meeting.
- D. Provide construction submittals and shop drawings to CxP as described above in SUBMITTALS.
- E. Provide engineering data as required by CxP to prepare Construction Checklists within four weeks after date of approved submittal.
- F. CxP will conduct an initial commissioning coordination meeting approximately 30 days before equipment begins to arrive at the project site to coordinate commissioning activities and execution of construction checklists. Additional commissioning coordination meetings will be scheduled as necessary throughout the process to discuss commissioning schedule and coordination among trades.
- G. Perform Construction Checks as equipment is received, installed, and placed in operation. Construction checks shall be performed as work is completed. For example, equipment inspection shall be performed upon receipt of equipment on site, installation inspection shall be performed when equipment is set in place and anchored, and so on.
- H. Submit control verification reports at Substantial Completion.

#### **1.07 FUNCTIONAL TESTING WILL BE SCHEDULED AFTER CONSTRUCTION CHECKLISTS; TESTING, ADJUSTING, AND BALANCING REPORT; AND CONTROL VERIFICATION REPORTS HAVE BEEN SUBMITTED AND ACCEPTED. CONTRACTOR SHALL PROVIDE WRITTEN NOTICE THAT SYSTEMS ARE COMPLETELY OPERATIONAL AND READY FOR FUNCTIONAL TESTING. FUNCTIONAL TESTING MAY PROCEED PRIOR TO ACCEPTANCE IF THE CXP AND OWNER'S AUTHORIZED REPRESENTATIVE DETERMINES THAT DEFICIENCIES WILL NOT SIGNIFICANTLY AFFECT SYSTEM PERFORMANCE AND TIMING IS CRITICAL. THE CXP WILL PROVIDE NOTIFICATION TO CONTRACTOR, ARCHITECT, AND OWNER'S AUTHORIZED REPRESENTATIVE A MINIMUM OF ONE WEEK PRIOR TO PERFORMING FUNCTIONAL TESTING.**

- A. Troubleshooting, corrections, and retesting shall be completed within three months of Substantial Completion.



### 1.08 SYSTEMS TO BE COMMISSIONED

- A. Commissioning of a system or systems specified for this project is part of the construction process. Documentation and testing of these systems, as well as training of the operation and maintenance personnel, is required in cooperation with the CxP.
- B. The following systems will be commissioned as part of this project:
  - 1. Heating, ventilation and air-conditioning systems
    - a. Air handling units
    - b. Heat recovery units
  - 2. Dedicated outside air units
    - a. Fan coil units
    - b. Exhaust fans
    - c. Split-system air conditioning units
    - d. Terminal units
    - e. Terminal devices (unit heaters, finned tube radiators, etc.)
    - f. Active chilled beams
    - g. Passive chilled beams
    - h. Heating water piping
    - i. Chilled water piping
    - j. Steam condensate piping
    - k. Hydronic boilers and associated pumping
    - l. Steam boiler
    - m. Steam condensate receiver and pumping
    - n. Ductwork
    - o. Building automation control system
    - p. Packaged control systems
    - q. Variable frequency drives
  - 3. Plumbing Systems
    - a. Water heaters
    - b. Sump and sewage pumps
    - c. Recirculation pumps
    - d. Laboratory air, vacuum, gas
    - e. Deionized water and reverse osmosis systems
    - f. Packaged air compressors
    - g. Rainwater reclamation system
    - h. Solar hot water system
    - i. Irrigation system
    - j. Fire protection
  - 4. Electrical systems
    - a. Metering devices
    - b. Secondary power
    - c. Lighting fixtures
    - d. Lighting controls
    - e. Backup power system
      - 1) Generator
      - 2) Automatic transfer switches
    - f. Photovoltaic system
    - g. Fire alarm
    - h. Access control
    - i. Security and video surveillance system
    - j. Intercom and paging

## **PART 2 - PRODUCTS**

### **2.01 MATERIALS**

- A. Provide specialized test equipment including manufacturer's proprietary test equipment, as necessary for commissioning of mechanical, plumbing and electrical systems and components. Comply with requirements of individual technical Sections of Division 22, 23, and 26. Common test equipment such as temperature, pressure, speed, and electrical power measuring devices shall be provided by CxP.

## **PART 3 - EXECUTION**

### **3.01 APPLICATION**

- A. Commissioning Meetings: Commissioning Team shall attend meetings as required by CxP including Commissioning Process Meeting, submittal review meetings, and coordination meetings prior to construction checks; adjusting and balancing; and functional testing. Commissioning team shall attend troubleshooting meetings as required to resolve issues identified in submittal reviews and commissioning reports.
- B. Construction Checklists:
  - 1. Provide equipment installation, start-up, and operating information requested by the CxP as required to develop Construction checklists.
  - 2. Perform construction checks for all equipment being commissioned as described in Construction Checklists prior to equipment start-up. The Contractor shall designate responsibility for completing construction checks among subcontractors. The designated subcontractor shall initial and date each item on checkout sheets as completed and submit executed forms to CxP for certification. All items listed in the Construction Checklists shall be complete prior to certification unless the incomplete item does not affect safe and reliable equipment operation. If such an item is identified, a description of the incomplete work must be attached to the Construction Checklists. Equipment requiring construction checkout shall not be started until the Construction Checklists are fully executed by the Contractor.
  - 3. Contractor shall maintain "Cx Submittal Status Report." CxP will furnish Excel status report spreadsheet that will be used to monitor completion of construction checklists.
  - 4. Contractor shall startup equipment as described in construction checklists. Where required, provide manufacturer's agent to perform start-up as specified in Divisions 22, 23, and 26
  - 5. Fully executed Construction Checklists shall be submitted to the CxP for certification.
  - 6. CxP will document unresolved issues in a project Issues Log. The Issues Log documents status, responsibility, and required action for each unresolved issue.
  - 7. CxP shall perform a recheck of selected equipment. If minor discrepancies are identified, Contractor shall recheck all similar systems and resubmit Construction Check forms for certification. If major discrepancies are identified, CxP shall perform Construction Checks, and Contractor shall compensate Owner for additional commissioning costs by Contract modification.
- C. Control Verification Reports:
  - 1. Perform control system verification and prepare verification reports as specified in Divisions 23 and 26. Verification shall be performed by manufacturer's authorized installation contractor. Verification report shall include a description of the incomplete work.
  - 2. Submit completed Control Verification Reports to the CxP for acceptance.
  - 3. CxP will document unresolved issues in a project Issues Log. The Issues Log documents status, responsibility, and required action for each unresolved issue.
- D. Functional Tests:

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1. Assist CxP in performing Functional Tests, which shall generally include operating equipment and systems as necessary for testing. The CxP will record test measurements and documentation of results.
  2. CxP will document all unresolved issues in a project Issues Log. The Issues Log documents status, responsibility, and required action for each unresolved issue.
  3. CxP shall retest selected systems once to verify that corrective work is complete. Retests will be performed after notification from the Contractor that work is complete. If corrective work is not complete and additional retesting is required, Contractor shall compensate Owner for costs of additional CxP testing sessions by Contract modification.
- E. Issues Resolution: Unresolved issues will be listed in the project online Issues Log. Refer to Online Commissioning System in Article 1.03, Definitions above. Each issue will be identified with an identification number. The Issues Log will include a description of the unresolved condition, identify the responsible individual(s), and describe suggested corrective action. The Contractor will periodically access the On-line Commissioning System to monitor the status of commissioning issues, and shall diligently complete all tasks that are identified as the responsibility of the Contractor. The Contractor shall modify on-line issue status when each item is completed and provide a description of corrective action performed. Contractor and related subcontractors shall attend commissioning meetings to review the Issues Log and coordinate resolution of issues as required by the CxP.

### **3.02 QUALITY CONTROL**

- A. Provide mechanics that are experienced with the Work and installed components of each system to assist in completion of the commissioning activities.
1. Work necessary to provide systems complying with performance requirements of the contracts is the Contractor's responsibility.
- B. Manufacturer's Field Services: Provide manufacturer's representatives with expertise in components and systems. Where required, manufacturer's representative shall perform start-up, testing, and maintenance training of Owner's facilities staff including classroom and onsite instruction.

### **3.03 ACCESS TO WORK**

- A. Contractor shall provide facilities and access for CxP to perform work including but not limited to:
1. Keys, security passes, passwords, codes, etc.
  2. Ladders.
  3. Lifts where work is more than 12 feet above floor level.
  4. Removal of ceiling tiles, partitions, panels, or other fixed construction necessary for completion of work.
  5. Proprietary programming and metering equipment.

**END OF SECTION**

**SECTION 024100  
DEMOLITION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Selective demolition of building elements for alteration purposes.

**PART 2 EXECUTION**

**2.01 GENERAL PROCEDURES AND PROJECT CONDITIONS**

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
  - 1. Obtain required permits.
  - 2. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
  - 3. Provide, erect, and maintain temporary barriers and security devices.
  - 4. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
  - 5. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
  - 6. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.
  - 7. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
  - 8. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from Owner.
- C. Protect existing structures and other elements to remain in place and not removed.
  - 1. Provide bracing and shoring.
  - 2. Prevent movement or settlement of adjacent structures.
  - 3. Stop work immediately if adjacent structures appear to be in danger.
- D. Hazardous Materials:
  - 1. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCBs, and mercury.
- E. Perform demolition in a manner that maximizes salvage and recycling of materials.
  - 1. Dismantle existing construction and separate materials.
  - 2. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

**2.02 SELECTIVE DEMOLITION FOR ALTERATIONS**

- A. Existing construction and utilities indicated on drawings are based on casual field observation and existing record documents only.
  - 1. Verify construction and utility arrangements are as indicated.
  - 2. Report discrepancies to Architect before disturbing existing installation.
  - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Separate areas in which demolition is being conducted from areas that remain occupied.

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1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 015000 .
- C. Remove existing work as indicated and required to accomplish new work.
  1. Remove items indicated on drawings.
- D. Services including, but not limited to, HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications: Remove existing systems and equipment as indicated.
  1. Maintain existing active systems to remain in operation, and maintain access to equipment and operational components.
  2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
  3. Verify that abandoned services serve only abandoned facilities before removal.
  4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings. Remove back to source of supply where possible, otherwise cap stub and tag with identification.
- E. Protect existing work to remain.
  1. Prevent movement of structure. Provide shoring and bracing as required.
  2. Perform cutting to accomplish removal work neatly and as specified for cutting new work.
  3. Repair adjacent construction and finishes damaged during removal work.
  4. Patch to match new work.

**2.03 DEBRIS AND WASTE REMOVAL**

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

**END OF SECTION**

**SECTION 035400  
CAST UNDERLAYMENT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Liquid-applied self-leveling floor underlayment.
  - 1. Use gypsum-based type at Supply Room 194.

**1.02 REFERENCE STANDARDS**

- A. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete 2018.
- B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters, and Gypsum Concrete 2020.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.

**1.03 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Keep dry and protect from direct sun exposure, freezing, and ambient temperature greater than 105 degrees F (41 degrees C).

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Gypsum Underlayment:
  - 1. Arcosa Specialty Products: [www.acgmaterials.com](http://www.acgmaterials.com)
  - 2. ARDEX Engineered Cements; ARDEX K 22 F: [www.ardexamericas.com](http://www.ardexamericas.com)
  - 3. Maxxon Corporation: [www.maxxon.com](http://www.maxxon.com)
  - 4. USG: [www.usg.com](http://www.usg.com)
  - 5. Substitutions: See Section 016310 - Product Substitutions.

**2.02 MATERIALS**

- A. Gypsum-Based Underlayment: Gypsum based mix, that when mixed with water in accordance with manufacturer's directions will produce self-leveling underlayment with the following properties:
  - 1. Compressive Strength: Minimum 2500 pounds per square inch (17.24 MPa), tested per ASTM C472.
  - 2. Density: Maximum 115 pounds per cubic foot (1842 kg/cu m).
  - 3. Final Set Time: 1 to 2 hours, maximum.
  - 4. Thickness: 1 inch (25.4 mm).
  - 5. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0 in accordance with ASTM E84.
- B. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to underlayment mix materials.
- C. Primer: Manufacturer's recommended type.
- D. Joint and Crack Filler: Latex based filler, as recommended by manufacturer.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that substrate surfaces are clean, dry, unfrozen, do not contain petroleum byproducts, or other compounds detrimental to underlayment material bond to substrate.

**3.02 PREPARATION**

- A. Remove substrate surface irregularities. Fill voids and deck joints with filler. Finish smooth.
- B. Vacuum clean surfaces.
- C. Prime substrate in accordance with manufacturer's instructions. Allow to dry.
- D. Close floor openings.

**3.03 APPLICATION**

- A. Install underlayment in accordance with manufacturer's instructions.
- B. Place to indicated thickness, with top surface level to 1/8 inch in 10 ft (1:1000).
- C. Place after partition installation.

**3.04 PROTECTION**

- A. Protect against direct sunlight, heat, and wind; prevent rapid drying to avoid shrinkage and cracking.
- B. Do not permit traffic over unprotected floor underlayment surfaces.

**END OF SECTION**

**SECTION 060660  
PLASTIC FABRICATIONS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. 3Form Translucent Resin Panel System

**PART 2 PRODUCTS**

**2.01 MANUFACTURER**

- A. Manufacturer: 3form, LLC., Salt Lake City, Utah, USA / telephone 801-649-2500

**2.02 MATERIALS**

- A. 3form Chroma
1. Engineered acrylic resin produced in the USA
  2. Sheet Size: Maximum 4' x 10'
  3. Thickness: Minimum 3/8"
  4. Basis of Design Product: The design of Plastic Fabrications is based on Chroma as provided by 3form, Inc. Products from other manufacturers must be approved by the Architect or Designer prior to bidding in accordance with the Instructions to Bidders and Section 10 60 00 "Product Requirements". 3form designs are protected by registered copyrights and patents, and may not be duplicated. Copied designs will be considered a violation of intellectual property rights and will be pursued.
- B. Sheet minimum performance attributes:
1. Rate of Burning (ASTM D 635). Material must attain CC2 Rating for a nominal thickness of 1.5 mm (0.060 in.) and greater.
  2. Self-Ignition Temperature (ASTM D 1929). Material must have a Self-ignition temperature greater than 850°F.
  3. Density of Smoke (ASTM D 2843). Material must have a smoke density less than 10%.
  4. Coefficient of Friction (ASTM 2047) 0.73 Dry, 0.79 Wet
  5. Dynamic environmental testing (ASTM standards D 5116 or D 6670). Panels must not have detectable VOC off-gassing agents and must be have Greenguard™ Indoor Air Quality Children and Schools certified.
  6. Product must be fused using heat and pressure, not laminated with adhesives.
  7. Color must be PVC-Free and be an acrylic resin made with pigments, not dyes. Must be UV stable colors
  8. Vellum surface should be completely renewable onsite.

**2.03 FABRICATION**

- A. General: Fabricate Plastic Fabrications to designs, sizes and thicknesses indicated and to comply with indicated standards. Sizes, profiles and other characteristics are indicated on the drawings, additional fabrication and installation details can be found on the 3form Fabrication Drawings.
- B. Comply with manufacturer's written recommendations for fabrication.
- C. Machining: Acceptable means of machining are listed below. Ensure that material is not chipped or warped by machining operations.
1. Sawing: Select equipment and blades suitable for type of cut required.
  2. Drilling: Drills compatible with plastic products.
  3. Routing
  4. Laser Cutting
  5. Laser Etching



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- D. Forming: Form products to shapes indicated using the appropriate method listed below. Comply with manufacturer's written instructions.
  - 1. Cold Bending
  - 2. Hot Bending
  - 3. Thermoforming: Acceptable only on uncoated material.
  - 4. Drape Forming
  - 5. Matched Mold Forming
  - 6. Mechanical Forming
- E. Laminating: Laminate to substrates indicated using adhesives and techniques recommended by manufacturer.
- F. Bonding
  - 1. Manufacturer must have an in-field seaming process and fabrication kit including necessary adhesive and tools.

#### **2.04 MISCELLANEOUS MATERIALS**

- A. General: Provide products of material, size, and shape required for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaner: Type recommended by manufacturer.
- C. Adhesives: May be achieved with 2-part adhesives or silicones, suitable for use with product and application.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine substrates, areas, and conditions where installation of Plastic Fabrications will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for installation and comply with requirements specified.

#### **3.02 INSTALLATION**

- A. General: Comply with manufacturer's written instructions for the installation of Plastic Fabrications. Sizes, profiles and other characteristics are indicated on the drawings, additional installation details can be found on the 3form Certified Installer, if applicable.
- B. Manufacturer's shop to fabricate items to the greatest degree possible.
- C. Utilize fasteners, adhesives and bonding agents recommended by manufacturer for type of installation indicated. Material that is chipped, warped, hazed or discolored as a result of installation or fabrication methods will be rejected.
- D. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data.
- E. Form field joints using manufacturer's recommended procedures. Locate seams in panels so that they are not directly in line with seams in substrates.
- F. We recommend that installation is completed by a 3form Certified Installer. Contact 3form for more information or to get a quote.

#### **3.03 CLEANING AND PROTECTION**

- A. Protect surfaces from damage until date of substantial completion. Repair work or replace damaged work, which cannot be repaired to Architect's satisfaction.

#### **3.04 SCHEDULE**

- A. ACR-1
  - 1. Acrylic Panel
    - a. Product: 3Form

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- b. Style: Chroma
- c. Color: Clear Frost
- d. Size: As indicated on drawings
- e. Location: Check-In / Check-Out (103) & Lab Check-In divider walls

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**SECTION 061000  
ROUGH CARPENTRY**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Nonstructural dimension lumber framing.
- B. Rough opening framing for doors, windows, and roof openings.
- C. Sheathing.
- D. Underlayment.
- E. Fire retardant treated wood materials.
- F. Communications and electrical room mounting boards.
- G. Concealed wood blocking, nailers, and supports.

**1.02 RELATED REQUIREMENTS**

- A. Section 092116 - Gypsum Board Assemblies: Gypsum-based sheathing.

**1.03 REFERENCE STANDARDS**

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- B. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing 2019a.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.
- D. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022.
- E. AWPA U1 - Use Category System: User Specification for Treated Wood 2022.
- F. PS 20 - American Softwood Lumber Standard 2021.
- G. WWPA G-5 - Western Lumber Grading Rules 2021.

**1.04 SUBMITTALS**

- A. See Section 013000 Submittals for submittal procedures.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

**PART 2 PRODUCTS**

**2.01 GENERAL REQUIREMENTS**

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
  - 1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
  - 2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at [www.alsc.org](http://www.alsc.org), and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

## **2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS**

- A. Grading Agency: Western Wood Products Association; WWPA G-5.
- B. Sizes: Nominal sizes as indicated on drawings, S4S.
- C. Moisture Content: Kiln-dry or MC15.
- D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
  - 1. Lumber: S4S, No. 2 or Standard Grade.

## **2.03 CONSTRUCTION PANELS**

- A. Underlayment: APA Underlayment; plywood, Exposure 2, 1/4 inch (7 mm) thick. Fully sanded faces at resilient flooring.

## **2.04 ACCESSORIES**

- A. Fasteners and Anchors:
  - 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
  - 2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
- B. Subfloor Adhesives: Gap-filling construction adhesive for bonding wood structural panels to wood-based floor system framing; complying with ASTM D3498.

## **2.05 FACTORY WOOD TREATMENT**

- A. Treated Lumber and Plywood: Comply with requirements of AWWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
  - 1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
- B. Fire Retardant Treatment:
  - 1. Interior Type A: AWWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
    - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
    - b. Treat rough carpentry items as indicated .
    - c. Do not use treated wood in applications exposed to weather or where the wood may become wet.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION - GENERAL**

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

### **3.02 BLOCKING, NAILERS, AND SUPPORTS**

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

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- B. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- C. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

**3.03 INSTALLATION OF CONSTRUCTION PANELS**

- A. Underlayment: Secure to subflooring with nails and glue.
  - 1. Place building paper between floor underlayment and subflooring.
- B. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches (610 mm) on center on all edges and into studs in field of board.
  - 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
  - 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
  - 3. Install adjacent boards without gaps.
  - 4. Size and Location: As indicated on drawings.

**3.04 CLEANING**

- A. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.
- B. Prevent sawdust and wood shavings from entering the storm drainage system.

**END OF SECTION**

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**SECTION 062000  
FINISH CARPENTRY**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Hardware and attachment accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 061000 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- B. Section 099123 - Interior Painting: Painting of finish carpentry items.

**1.03 REFERENCE STANDARDS**

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.
- B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition 2014, with Errata (2016).
- C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards 2021, with Errata.

**1.04 SUBMITTALS**

- A. See Section 013000 Submittals for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver factory-fabricated units to project site in original packages, containers or bundles bearing brand name and identification.
- B. Protect from moisture damage.
- C. Handle materials and products to prevent damage to edges, ends, or surfaces.

**PART 2 PRODUCTS**

**2.01 FINISH CARPENTRY ITEMS**

**2.02 HARDWARE**

- A. Specialty Workstation and Countertop Brackets:
  - 1. Material: Steel.
  - 2. Finish: Manufacturer's standard, factory-applied, powder coat.
  - 3. Color: Selected by Architect from manufacturer's standard range..

**2.03 FABRICATION**

- A. Shop assemble work for delivery to site, permitting passage through building openings.
- B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify adequacy of backing and support framing.

**3.02 INSTALLATION**

- A. Set and secure materials and components in place, plumb and level.
- B. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim to conceal larger gaps.



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**3.03 TOLERANCES**

- A. Maximum Variation from True Position: 1/16 inch (1.6 mm).
- B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch (0.79 mm).

**END OF SECTION**

**SECTION 072100  
THERMAL INSULATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Batt insulation in wood stud cavity.

**1.02 REFERENCE STANDARDS**

- A. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications 2013 (Reapproved 2019).
- B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation 2022.
- C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.

**1.03 SUBMITTALS**

- A. See Section 013000 Submittals for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

**1.04 FIELD CONDITIONS**

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

**PART 2 PRODUCTS**

**2.01 APPLICATIONS**

- A. Insulation in Wood Framed Walls: Batt insulation with no vapor retarder.

**2.02 ACOUSTIC BATT INSULATION MATERIALS**

- A. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed insulation, complying with ASTM C665; friction fit.
  - 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
  - 2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
  - 3. Thermal Resistance: R-value (RSI-value) of [R-13] ([\_\_\_\_\_]).
  - 4. Products:
    - a. Johns Manville; MinWool Sound Attenuation Fire Batts: [www.jm.com](http://www.jm.com)
    - b. Knauf Insulation; EcoBatt Insulation: [www.knaufinsulation.com](http://www.knaufinsulation.com)
    - c. ROCKWOOL; COMFORTBATT: [www.rockwool.com](http://www.rockwool.com)
    - d. Thermafiber, Inc; SAFB: [www.thermafiber.com](http://www.thermafiber.com)
    - e. Substitutions: See Section 016310 - Product Substitutions.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

**3.02 BATT INSTALLATION**

- A. Install insulation in accordance with manufacturer's instructions.

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- B. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- C. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

**3.03 PROTECTION**

- A. Do not permit installed insulation to be damaged prior to its concealment.

**END OF SECTION**

**SECTION 079200  
JOINT SEALANTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Nonsag gunnable joint sealants.
- B. Joint backings and accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions: Additional requirements for sealants and primers.
- B. Section 092116 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.
- C. Section 093000 - Tiling: Sealant between tile and plumbing fixtures and at junctions with other materials and changes in plane.

**1.03 REFERENCE STANDARDS**

- A. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants 2018 (Reapproved 2022).
- B. ASTM C834 - Standard Specification for Latex Sealants 2017.
- C. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications 2022.
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
- E. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems 2016.
- F. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.
- G. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants 2022.

**1.04 SUBMITTALS**

- A. See Section 013000 Submittals for submittal procedures.
- B. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:
  - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
  - 2. List of backing materials approved for use with the specific product.
  - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
  - 4. Substrates the product should not be used on.
- C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
- D. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required sealant.
- E. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.
- F. Executed warranty.

**1.05 WARRANTY**

- A. Manufacturer Warranty: Provide 2-year manufacturer warranty for installed sealants and accessories that fail to achieve a watertight seal, exhibit loss of adhesion or cohesion, or do not cure. Complete forms in Owner's name and register with manufacturer.

- B. Extended Correction Period: Correct defective work within 5 year period commencing on Date of Substantial Completion.

## **PART 2 PRODUCTS**

### **2.01 JOINT SEALANT APPLICATIONS**

- A. Scope:
1. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
    - a. Joints between door, window, and other frames and adjacent construction.
    - b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
    - c. Other joints indicated below.
  2. Do not seal the following types of joints:
    - a. Joints indicated to be treated with manufactured expansion joint cover, or some other type of sealing device.
    - b. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
    - c. Joints where installation of sealant is specified in another section.
    - d. Joints between suspended panel ceilings/grid and walls.
- B. Interior Joints: Use nonsag polyurethane sealant, unless otherwise indicated.
1. Joints between Tile in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
  2. In Sound-Rated Assemblies: Acrylic emulsion latex sealant.
- C. Interior Wet Areas: Bathrooms and restrooms; fixtures in wet areas include plumbing fixtures, countertops, cabinets, and other similar items.
- D. Sound-Rated Assemblies: Walls and ceilings identified as STC-rated, sound-rated, or acoustical.

### **2.02 NONSAG JOINT SEALANTS**

- A. Nonstaining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
1. Nonstaining to Porous Stone: Nonstaining to light-colored natural stone when tested in accordance with ASTM C1248.
  2. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
  3. Color: To be selected by Architect from manufacturer's standard range.
- B. Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 10 percent, minimum.
- C. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
1. Color: White.
- D. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 25 percent, minimum.
  2. Color: Match adjacent finished surfaces.
- E. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, nonstaining, nonbleeding, nonsagging; not intended for exterior use.

### **2.03 ACCESSORIES**

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.

### **3.02 INSTALLATION**

- A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Provide joint sealant installations complying with ASTM C1193.
- C. Install acoustical sealant application work in accordance with ASTM C919.
- D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- E. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- F. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

**END OF SECTION**

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**SECTION 081213  
HOLLOW METAL FRAMES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Non-fire-rated hollow metal frames for non-hollow metal doors.
- B. Fire-rated hollow metal frames for non-hollow metal doors.

**1.02 RELATED REQUIREMENTS**

- A. Section 081416 - Flush Wood Doors: Non-hollow metal door for hollow metal frames.
- B. Section 087100 - Door Hardware: Hardware, silencers, and weatherstripping.
- C. Section 088000 - Glazing: Glazed borrowed lites.
- D. Section 099123 - Interior Painting: Field painting.

**1.03 REFERENCE STANDARDS**

- A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.
- B. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100) 2017.
- C. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames 2020.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- E. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2021a.
- F. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2018a.
- G. BHMA A156.115 - Hardware Preparation in Steel Doors and Steel Frames 2016.
- H. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.
- I. ITS (DIR) - Directory of Listed Products Current Edition.
- J. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames 2002.
- K. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames 2011.
- L. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames 2017.
- M. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2022.
- N. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2022.
- O. UL (DIR) - Online Certifications Directory Current Edition.
- P. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 013000 Submittals for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.



- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.
- D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- E. Manufacturer's qualification statement.

#### **1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Maintain at project site copies of reference standards relating to installation of products specified.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Store in accordance with applicable requirements and in compliance with standards and/or custom guidelines as indicated.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Hollow Metal Frames:
  - 1. Ceco Door, an Assa Abloy Group company: [www.assaabloydss.com](http://www.assaabloydss.com)
  - 2. Curries, an Assa Abloy Group company: [www.assaabloydss.com](http://www.assaabloydss.com)
  - 3. Republic Doors, an Allegion brand: [www.republicdoor.com](http://www.republicdoor.com)
  - 4. Substitutions: See Section 016310 - Product Substitutions.

#### **2.02 PERFORMANCE REQUIREMENTS**

- A. Refer to Door and Frame Schedule on drawings for frame sizes, fire ratings, sound ratings, finishing, door hardware to be installed, and other variations, if any.
- B. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
- C. Accessibility: Comply with ICC A117.1 and ADA Standards.
- D. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior frame that is also indicated as being sound-rated must comply with the requirements specified for exterior frames and for sound-rated frames; where two requirements conflict, comply with the most stringent.
- E. Hardware Preparations, Selections and Locations: Comply with BHMA A156.115, NAAMM HMMA 830, NAAMM HMMA 831 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

#### **2.03 HOLLOW METAL DOOR FRAMES**

- A. Frame Finish: Factory primed and field finished.
- B. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
  - 1. Frame Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
  - 2. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inches (152 mm) above floor at 45 degree angle.
- C. Fire-Rated Door Frames: Face welded type.
  - 1. Frame Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.

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2. Fire Rating: As indicated on Door and Frame Schedule, tested in accordance with UL 10C or NFPA 252 ("positive pressure fire tests").
3. Provide units listed and labeled by ITS (DIR) or UL (DIR).
  - a. Attach fire rating label to each fire rated unit.

#### **2.04 FINISHES**

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

#### **2.05 ACCESSORIES**

- A. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- B. Removable Stops: Formed sheet steel, mitered or butted corners; prepared for countersink style tamper proof screws.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

#### **3.02 PREPARATION**

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

#### **3.03 INSTALLATION**

- A. Install frames in accordance with manufacturer's instructions and related requirements of specified frame standards or custom guidelines indicated.
- B. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Comply with glazing installation requirements of Section 088000.
- E. Install door hardware as specified in Section 087100.
- F. Coordinate installation of electrical connections to electrical hardware items.

#### **3.04 TOLERANCES**

- A. Maximum Diagonal Distortion: 1/16 inch (1.5 mm) measured with straight edges, crossed corner to corner.

#### **3.05 SCHEDULE**

- A. Refer to Door and Frame Schedule on the drawings.

**END OF SECTION**

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**SECTION 081416  
FLUSH WOOD DOORS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Flush wood doors; flush configuration; non-rated.

**1.02 RELATED REQUIREMENTS**

- A. Section 081113 - Hollow Metal Doors and Frames.
- B. Section 087100 - Door Hardware.
- C. Section 088000 - Glazing.

**1.03 REFERENCE STANDARDS**

- A. ANSI A135.4 - Basic Hardboard 2012 (Reaffirmed 2020).
- B. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).
- C. ASTM E413 - Classification for Rating Sound Insulation 2022.
- D. AWI (QCP) - Quality Certification Program Current Edition.
- E. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition 2014, with Errata (2016).
- F. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards 2021, with Errata.
- G. NEMA LD 3 - High-Pressure Decorative Laminates 2005.
- H. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2022.
- I. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.
- J. UL 1784 - Standard for Air Leakage Tests of Door Assemblies Current Edition, Including All Revisions.
- K. WDMA I.S. 1A - Interior Architectural Wood Flush Doors 2021, with Errata.

**1.04 SUBMITTALS**

- A. See Section 013000 Submittals for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
  - 1. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
- D. Samples: Submit two samples of door veneer, 6 by 6 inches ([ ] by [ ] mm) in size illustrating wood grain, stain color, and sheen.
- E. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
- F. Manufacturer's qualification statement.
- G. Specimen warranty.
- H. Warranty, executed in Owner's name.

**1.05 QUALITY ASSURANCE**

- A. Maintain one copy of the specified door quality standard on site for review during installation and finishing.

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- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.
  - 1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- C. Woodwork Quality Assurance Program:
  - 1. Comply with AWI (QCP) woodwork association quality assurance service/program in accordance with requirements for work specified in this section; [www.awiqcp.org](http://www.awiqcp.org)
  - 2. Provide labels indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
  - 3. Provide designated labels on shop drawings as required by quality assurance program.
  - 4. Provide designated labels on installed products as required by quality assurance program.
  - 5. Submit documentation upon completion of installation that verifies this work is in compliance with specified requirements.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging, and inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

#### **1.07 WARRANTY**

- A. Interior Doors: Provide manufacturer's warranty for the life of the installation.
- B. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Wood Veneer Faced Doors:
  - 1. VT Industries, Inc: [www.vtindustries.com](http://www.vtindustries.com)
  - 2. Marshfield Door Systems
  - 3. Algoma
  - 4. Eggers Industries
  - 5. Substitutions: See Section 016310 - Product Substitutions.

#### **2.02 DOORS**

- A. Doors: See drawings for locations and additional requirements.
  - 1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS), AWMAC/WI (NAAWS) or WDMA I.S. 1A.
  - 2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
  - 3. Wood Species: White Maple
  - 4. Finish: Ravine RA18 White Maple (Match VT Industries Standard Color)
- B. Interior Doors: 1-3/4 inches (44 mm) thick unless otherwise indicated; flush construction.
  - 1. Provide solid core doors at each location.
  - 2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.

#### **2.03 DOOR AND PANEL CORES**

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.

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- B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

#### **2.04 DOOR FACINGS**

- A. Veneer Facing for Transparent Finish:
  - 1. Vertical Edges: Same species as face veneer.

#### **2.05 DOOR CONSTRUCTION**

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
  - 1. Provide solid blocks at lock edge for hardware reinforcement.
  - 2. Provide solid blocking for other throughbolted hardware.
- C. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
- D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- F. Provide edge clearances in accordance with the quality standard specified.

#### **2.06 FINISHES - WOOD VENEER DOORS**

- A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
- B. Finish work in accordance with WDMA I.S. 1A for grade specified and as follows:
  - 1. Transparent:
    - a. Manufacturers standard, in compliance with performance duty level indicated.
    - b. Stain: As selected by Architect.
    - c. Sheen: Satin.
- C. Factory finish doors in accordance with approved sample.

#### **2.07 ACCESSORIES**

- A. Hollow Metal Door Frames: See Section 081113.
- B. Door Window Frames: Door window frames with glazing securely fastened within door opening.
  - 1. Size: As indicated on drawings.
  - 2. Glazing: 1/4 inch (6.4 mm) thick, tempered glass, in compliance with requirements of authorities having jurisdiction.
- C. Door Hardware: See Section 087100.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

#### **3.02 INSTALLATION**

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
  - 1. Install fire-rated doors in accordance with NFPA 80 requirements.

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- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.

**3.03 ADJUSTING**

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

**3.04 SCHEDULE**

- A. See Door and Frame Schedule on the drawings.

**END OF SECTION**

**SECTION 083100  
ACCESS DOORS AND PANELS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Floor-mounted access door and frame units, interior.

**1.02 SUBMITTALS**

- A. See Section 013000 Substitutions for submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- C. Shop Drawings: Indicate exact position of each access door and/or panel unit.

**1.03 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

**PART 2 PRODUCTS**

**2.01 ACCESS DOORS AND PANELS ASSEMBLIES**

- A. Interior Floor-Mounted Access Units:
  - 1. Location: As indicated on drawings.
  - 2. Size: 30 by 36 inches (762 by 915 mm).

**2.02 FLOOR-MOUNTED ACCESS UNITS**

- A. Manufacturers:
  - 1. ACUDOR Products Inc; ACUDOR FT-8040: [www.acudor.com](http://www.acudor.com)
  - 2. BILCO Company; Type T - Carpet or Composition Flooring: [www.bilco.com](http://www.bilco.com)
  - 3. Nystrom, Inc; FDRP - 1/8 inch Pan Architectural Floor Door, 300 psf: [www.nystrom.com](http://www.nystrom.com)
  - 4. Substitutions: See Section 016310 - Product Substitutions
- B. Floor-Mounted Access Units: Factory fabricated, fully assembled units with corner joints welded, filled, and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
  - 1. Size: As indicated on drawings.
  - 2. Hardware: Steel, hot-dipped galvanized.
    - a. Hinges: Removable pin.
- C. Interior Floor-Mounted Access Units: Aluminum, minimum 1/4 inch (6 mm) thick.
  - 1. Design Load: Design to support live load of 300 psf (14 kPa) with deflection not to exceed 1/180 of span.
  - 2. Operation: Manual opening, and manual closing.
  - 3. Cover: 1/8 inch (3.2 mm) deep recess with edge molding.
  - 4. Lift Handle: Recessed, non-removable.
  - 5. Finish: Mill finish.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that rough openings are correctly sized and located.
- B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

**3.02 PREPARATION**

- A. Clean surfaces thoroughly prior to proceeding with this work.



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- B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

**3.03 INSTALLATION**

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.

**END OF SECTION**

**SECTION 083400  
WOOD SLIDING DOOR ASSEMBLIES**

**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Interior Aluminum-Framed, Top-Hung Sliding Door Assemblies and Related Hardware.
- B. Related Sections:
  - 1. Division 08 Section "Door Hardware Schedule".
  - 2. Division 08 Section "Flush Wood Doors".
- C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
  - 1. ICC/ANSI A117.1 - Accessible and Usable Buildings and Facilities.
  - 2. ICC/IBC - International Building Code
  - 3. Window and Door Manufacturers Association - WDMA I.S. 1-A Architectural Wood Flush Doors.
  - 4. State Building Codes, Local Amendments.
- D. Standards: Comply with the following industry standards:
  - 1. UL 1784 Standard for Air Leakage Tests of Door Assemblies and Other Opening Protectives.

**1.03 SUBMITTALS**

- A. See Section 013000 Submittals for submittal procedures.
- B. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, door hardware and accessories, and finishes.
- C. Shop Drawings: Show details of fabrication and installation, including the following:
  - 1. Assembly elevations and sections indicating components and profiles, door hardware and accessories, and finishes.
  - 2. Door hardware locations, mounting heights, quantities, and installation requirements.
  - 3. Frame anchorages and wall reinforcement requirements.
- D. Samples for Verification: For each type of exposed finish indicated, provide samples below as a photo requested by Architect.
  - 1. Frame finish sample.
  - 2. Door veneer sample.
- E. Maintenance Data: For top-hung, sliding door assemblies include in maintenance manuals.

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Notify manufacturer immediately of any shipping damage.
- C. Storage and Handling Requirements:
  - 1. Store and handle materials in accordance with manufacturer's instructions.
  - 2. Keep materials in manufacturer's original, unopened containers and packaging until installation.

3. Store materials in clean, dry area indoors.
4. Protect materials and finish during storage, handling, and installation to prevent damage.

### **1.05 WARRANTY**

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Manufacturer's written warranty agreeing to repair or replace components of the top-hung, sliding door assemblies that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:
  1. Structural failures.
  2. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  3. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
  4. Telegraphing of core construction in wood face veneers exceeding 0.01 inch in a 3-inch span.
  5. Failure of operating components to function normally.
- C. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.
- D. General Warranty Period: One year from date of Substantial Completion.

## **PART 2 PRODUCTS**

### **2.01 PERFORMANCE REQUIREMENTS**

- A. Aluminum Frames: Aluminum cased opening perimeter frames manufactured with integral C-channel door cavity and acoustic seals.
- B. Closing Mechanism: Soft self-closing mechanism integrated with top track.
- C. Door Guide: Concealed type door guide.
- D. Accessibility Standards: Comply with applicable provisions in Accessibility Guidelines for Buildings and Facilities ICC (ANSI) A117.1 and requirements of authorities having jurisdiction.

### **2.02 MANUFACTURERS**

- A. Subject to compliance with requirements, provide the named product, or the comparable product by one of the alternate specified manufacturers. Comparable products are subject to review and approval through the submittal process specified.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. ASSA ABLOY
  2. AD Systems.

### **2.03 INTERIOR TOP-HUNG, SLIDING DOOR ASSEMBLIES**

- A. Basis-of-Design Manufacturer:
  1. ASSA ABLOY RITE SLIDE Sliding Door System (RS).
- B. Frame and Door Assembly Components:
  1. Single Piece Box Top Track: Extruded aluminum track system with mounting brackets.
  2. Fascia: Extruded aluminum with matching integral end caps.
  3. Integral Soft-Closer: Soft and self-closing damper mechanism.
  4. Concealed Door Bottom Floor Guide.
  5. Seal Sets: Integral to frame.
  6. Operating Hardware.
- C. Specified Wall Thickness:

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1. As indicated on Architectural Drawings.
- D. Frame Profiles: Extruded aluminum cased frame and trim with integral vertical jamb receiver channel.
  1. 1-1/2" Faces.
- E. Fascia Profile:
  1. Standard: Square.
  2. Custom Fascia Profile:
    - a. Round.
    - b. Chamfer.
- F. Frame Finish:
  1. Standard: Clear Anodized.
- G. Framing Anchors and Fastenings: Manufacturer's standard concealed anchors and fastenings.
- H. Flush Wood Door Construction:
  1. Standard: WDMA I.S.1-A Performance Grade: Extra Heavy Duty; Aesthetic Grade: A Premium.
  2. Minimum Thickness: 1-3/4".
  3. Core Construction" Particleboard Core Door (PC). Wood fiber based materials complying with ANSI A208.1 Particleboard standard. Grade LD-1.
  4. Face Veneer: As selected by Architect.
  5. Finish: Ravine RA18 White Maple (Match VT Industries Standard Color)
- I. Door Preparation. Doors leaves to be factory machined for hardware including pilot and function holes.
- J. Door Hardware Components:
  1. General: Heavy-duty, operating door hardware units in sizes, quantities, and types recommended by manufacturer for sliding door assemblies indicated.
  2. Cylinders and Keying: Refer to Division 08 Section "Door Hardware".

#### **2.04 FABRICATION**

- A. General: Fabricate top-hung, sliding door assemblies in sizes, profiles, and configurations indicated on Architectural Schedules and Drawings.
- B. Factory prepare door assemblies for field installation of door hardware and accessories to greatest extent possible.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify dimensions of wall openings.
- B. Examine wall openings and conditions, with Installer present, for plumb, level and square, and compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Sliding door operation will be adversely affected by out-of-tolerance framing.
- C. Examine surfaces to receive door bottom guide. Floor shall have no height variance throughout the complete sliding operation.
- D. Notify Architect of conditions that would adversely affect installation or subsequent use of sliding doors. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.02 DOOR, FRAME AND HARDWARE ASSEMBLY INSTALLATION**

- A. General: Comply with manufacturer's written installation instructions and approved shop drawings.
- B. Install frame components and sliding doors plumb, level, square, and in proper alignment.

- C. Anchor sliding door assemblies securely in place to supports according to manufacturer's written installation instructions.

### **3.03 ADJUSTING AND CLEANING**

- A. Adjust sliding doors and hardware for smooth operation in accordance with manufacturer's written instructions without binding and with tight fit at contact points and seals. Sliding doors to close against walls without gaps.
- B. Repair minor damages to finish in accordance with manufacturer's written instructions and as approved by Architect.

### **3.04 PROTECTION**

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure sliding door assemblies are without damage or deterioration at the time of Substantial Completion.

### **3.05 FIELD QUALITY CONTROL**

- A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
  - 1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

### **3.06 DOOR HARDWARE SETS**

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
  - 1. Refer to Section 087100, Door Hardware, for hardware sets.

**END OF SECTION**

**SECTION 085653  
SECURITY WINDOWS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Security view windows, with glazing.
- B. Security transaction windows with pass-through device.

**1.02 RELATED REQUIREMENTS**

- A. Section 079200 - Joint Sealants: Sealing joints between frames and adjacent construction.

**1.03 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's published data showing materials, construction details, dimensions of components, and finishes.
- C. Shop Drawings: Drawings prepared specifically for this project, showing plans, elevations, sections, details of construction, anchorage to other work, hardware, and glazing.
  - 1. For new work show required opening dimensions and allowance for field deviation.
  - 2. For field glazed windows, include detailed instructions for glazing installation.
- D. Samples for Selection of Applied Finishes: Color charts for factory finishes.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Firm with at least 5 years experience in the manufacture of windows of the type specified and able to provide test reports showing that their standard manufactured products meet the specified requirements; custom designed products not acceptable.
- B. Testing Agency Qualifications: Independent testing agency able to show experience in conducting tests of the type specified and:
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

**1.05 WARRANTY**

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Provide manufacturer's warranty agreeing to repair or replace windows and window components that fail within three years after Date of Substantial Completion due to, but not limited to, the following:
  - 1. Structural failure, failure of welds, and deterioration of metals and finishes beyond that expected under detention use and normal weathering.
  - 2. Failure of glazing due to excessive deflection of supporting members under wind load.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Security View Windows:
  - 1. Armortex Forced Entry Protection Products: [www.armortex.com](http://www.armortex.com)
  - 2. Substitutions: Not permitted.
- B. Security Transaction Windows with Pass-Through Device:
  - 1. Armortex Forced Entry Protection Products: [www.armortex.com](http://www.armortex.com)
  - 2. Insulgard Security Products: [www.insulgard.com](http://www.insulgard.com)
  - 3. Substitutions: Not permitted.

## **2.02 ASSEMBLIES**

- A. Security and Detention Windows:
1. Dimensions, profiles, features, and performance specified and indicated on drawings are required; do not deviate unless specifically approved by Architect under substitution procedures.
  2. Design to fit openings indicated on drawings; design to accommodate deviation of actual construction from dimensions indicated on drawings.
  3. Fabricate frames and sash with corners mitered or coped full depth with concealed welded joints.
  4. Design anchorages to provide performance equivalent to that required for window unit; provide anchorages at least equivalent to those by which the tested units were anchored to the test frame.
  5. Separate dissimilar metals to prevent corrosion by galvanic action by painting contact surfaces with primer or with sealant or tape recommended by manufacturer for the purpose.
  6. Weld components before finishing and in concealed locations, to greatest extent possible; minimize distortion and discoloration of finish; remove residue of welding; grind exposed welds smooth and finish to match.
  7. Label units to indicate which side is which, such as inside/outside or secure/non-secure; use labels that are removable after installation but durable enough not to be lost during delivery, storage, handling, and installation.

## **2.03 SECURITY VIEW WINDOWS**

- A. Security View Windows: Factory-assembled fixed glazing panel reglazable from secure side without disassembly of frame, with non-removable trim and glazing stops on non-secure side (outside).
1. Glazing: Laminated type; kind as required to achieve performance criteria specified.
  2. Ballistic Resistance: UL 752 Level 2 (high-power handgun).

## **2.04 SECURITY TRANSACTION WINDOWS WITH PASS-THROUGH DEVICE**

- A. Security Transaction Windows with Pass-Through Device at Reception:
1. Location: Built within interior wall, as indicated on drawings.
  2. Type of Use: Walk-up.
  3. Ballistic Resistance: Tested to meet UL 752, Level 2.
  4. Window Type: Fixed.
    - a. Window Size: As indicated on drawings.
    - b. Size of Counter Space: Manufacturer's standard size.
    - c. Material: Aluminum.
      - 1) Finish Color: Frames to match Sherwin Williams - SW7068 Grizzle Gray.
    - d. Sidelights: As indicated on drawings.
  5. Glazing: Single (monolithic), clear, and ballistic resistant.
  6. Shelf: Plastic laminate; Wilsonart #4926 Black Alicante.
  7. Communication: Standard talk-through portal.
  8. Products:
    - a. Armortex Forced Entry Protection Products; Bullet Resistant Aluminum Transaction Window Frames With Speak Thru: [www.armortex.com](http://www.armortex.com)
- B. Security Transaction Windows with Pass-Through Device at Lab:
1. Location: Built within interior wall, as indicated on drawings.
  2. Type of Use: Walk-up.
  3. Ballistic Resistance: Tested to meet UL 752, Level 2.
  4. Window Type: Fixed.

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- a. Overall Window Frame Size: As indicated on drawings.
- b. Frame Material: Aluminum.
  - 1) Finish: Frames to match Sherwin Williams - SW7068 Grizzle Gray
- 5. Glazing: Single (monolithic), clear, and ballistic resistant.
- 6. Pass-Through Device: Deal tray built into window sill.
  - a. Finish Color: As selected from manufacturer's standard colors.
- 7. Window Sill: Plastic laminate; Wilsonart #4926 Black Alicante.
- 8. Communication: Standard talk-through portal.
- 9. Products:
  - a. Insulgard Security Products; Square Top Design: [www.insulgard.com](http://www.insulgard.com)
  - b. Substitutions: Not permitted.

## **2.05 ASSEMBLY COMPONENTS**

- A. Frame Anchors: Mild steel plates, shapes, or bars, concealed in completed construction; provide anchorage devices as necessary to securely fasten windows to adjacent construction; use security fasteners for exposed anchors.
  - 1. Provide minimum of two anchors per side of window plus one additional anchor for each 18 inches (457 mm) or fraction thereof more than 36 inches (915 mm) in height or width.
- B. Glazing Seals: Factory installed; molded EPDM or neoprene compressible gaskets and compression strips.
- C. Deal Trays: Formed stainless steel, recessed into counter or sill for mounting under glazing frame.
  - 1. Style: Plain curved recess welded into counter or sill.
- D. Speaking Aperture Covers: Stainless steel, round, allowing passage of speech at normal volume without distortion; listed and labeled by UL (DIR) as bullet resisting to UL 752, same level as window.

## **2.06 FINISHES**

- A. Color: As selected by Architect from manufacturer's standard range.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that window openings are ready for installation of windows.
- B. Notify Architect if conditions are not suitable for installation of windows; do not proceed until conditions are satisfactory.

### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions and drawing details.
- B. Install windows in correct orientation (inside/outside or secure/non-secure).
- C. Anchor windows securely in manner so as to achieve performance specified.
- D. Set sill members and sill flashing in continuous bead of sealant.

### **3.03 ADJUSTING**

- A. Adjust operating components for smooth operation while also providing tight fit at contact points and a secure enclosure; lubricate operating hardware.

### **3.04 CLEANING**

- A. Clean exposed surfaces promptly after installation without damaging finishes.
- B. Remove and replace defective work.

**END OF SECTION**



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**SECTION 087100  
DOOR HARDWARE**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

- A. Door hardware and related items necessary for complete installation and operation of doors.

**1.02 RELATED WORK**

- A. Caulking: Section 079200 Joint Sealants
- B. Application of Hardware: Section 081416 Flush Wood Doors, Section 081213 Hollow Metal Frames
- C. Painting: Section 099123 Interior Painting
- D. Card Readers: Section 281000.
- E. Electrical: Division 26, Electrical

**1.03 GENERAL**

- A. All hardware shall comply with ABAAS, (Architectural Barriers Act Accessibility Standard) unless specified otherwise.
- B. Provide rated door hardware assemblies where required by most current version of the International Building Code (IBC).
- C. Hardware for Labeled Fire Doors and Exit Doors: Conform to requirements of NFPA 80 for labeled fire doors and to NFPA 101 for exit doors, as well as to other requirements specified. Provide hardware listed by UL, except where heavier materials, large size, or better grades are specified herein under paragraph HARDWARE SETS. In lieu of UL labeling and listing, test reports from a nationally recognized testing agency may be submitted showing that hardware has been tested in accordance with UL test methods and that it conforms to NFPA requirements.
- D. Hardware for application on metal and wood doors and frames shall be made to standard templates. Furnish templates to the fabricator of these items in sufficient time so as not to delay the construction.
- E. The following items shall be of the same manufacturer, except as otherwise specified:
  - F. Mortise locksets.
  - G. Hinges for hollow metal and wood doors.
  - H. Surface applied overhead door closers.
  - I. Exit devices.
  - J. Floor closers.

**1.04 WARRANTY**

- A. Automatic door operators shall be subject to the terms of FAR Clause 52.246-21, except that the Warranty period shall be two years in lieu of one year for all items except as noted below:
- B. Locks, latchsets, and panic hardware: 5 years.
- C. Door closers and continuous hinges: 10 years.

**1.05 SUBMITTALS**

- A. Submittals shall be in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Submit 6 copies of the schedule per Section 01 33 23. Submit 2 final copies of the final approved schedules to VAMC Locksmith as record copies (VISN Locksmith if the VAMC does not have a locksmith).

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- B. Hardware Schedule: AHC certified hardware consultant to prepare and submit hardware schedule in the following form:

Hardware Item	Quantity	Size	Reference Publication Type No.	Finish	Mfr. Name and Catalog No.	Key Control Symbols	UL Mark (if fire rated and listed)	ANSI/BHMA Finish Designation

- C. Samples and Manufacturers' Literature:
1. Samples: All hardware items (proposed for the project) that have not been previously approved by Builders Hardware Manufacturers Association shall be submitted for approval. Tag and mark all items with manufacturer's name, catalog number and project number.
  2. Samples are not required for hardware listed in the specifications by manufacturer's catalog number, if the contractor proposes to use the manufacturer's product specified.
- D. Certificate of Compliance and Test Reports: Submit certificates that hardware conforms to the requirements specified herein. Certificates shall be accompanied by copies of reports as referenced. The testing shall have been conducted either in the manufacturer's plant and certified by an independent testing laboratory or conducted in an independent laboratory, within four years of submittal of reports for approval.

**1.06 DELIVERY AND MARKING**

- A. Deliver items of hardware to job site in their original containers, complete with necessary appurtenances including screws, keys, and instructions. Tag one of each different item of hardware and deliver to COR for reference purposes. Tag shall identify items by Project Specification number and manufacturer's catalog number. These items shall remain on file in COR's office until all other similar items have been installed in project, at which time the COR will deliver items on file to Contractor for installation in predetermined locations on the project.

**1.07 PREINSTALLATION MEETING**

- A. Convene a preinstallation meeting not less than 30 days before start of installation of door hardware. Require attendance of parties directly affecting work of this section, including Contractor and Installer, Architect, Project Engineer and VA Locksmith, Hardware Consultant, and Hardware Manufacturer's Representative. Review the following:
1. Inspection of door hardware.
  2. Job and surface readiness.
  3. Coordination with other work.
  4. Protection of hardware surfaces.
  5. Substrate surface protection.
  6. Installation.
  7. Adjusting.
  8. Repair.
  9. Field quality control.
  10. Cleaning.

**1.08 INSTRUCTIONS**

- A. Hardware Set Symbols on Drawings: Except for protective plates, door stops, mutes, thresholds and the like specified herein, hardware requirements for each door are indicated on drawings by symbols. Symbols for hardware sets consist of letters (e.g., "HW") followed by a

number. Each number designates a set of hardware items applicable to a door type.

- B. Keying: All cylinders shall be keyed into existing key System. Provide removable core cylinders that are removable only with a special key or tool without disassembly of knob or lockset. Keying information shall be furnished at a later date by the COR.
  - 1. Keying information will be furnished to the Contractor by the COR.
  - 2. Supply information regarding key control of cylinder locks to manufacturers of equipment having cylinder type locks. Notify COR immediately when and to whom keys or keying information is supplied. Return all such keys to the COR.

#### 1.09 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. In text, hardware items are referred to by series, types, etc., listed in such specifications and standards, except as otherwise specified.
- B. ASTM International (ASTM):
  - 1. Padlocks
  - 2. E2180-18.....Standard Test Method for Determining the Activity of Incorporated Antimicrobial Agent(s) In Polymeric or Hydrophobic Materials
- C. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI/BHMA):
  - 1. A156.1-06.....Butts and Hinges
  - 2. A156.2-03.....Bored and Pre-assembled Locks and Latches
  - 3. A156.3-08.....Exit devices, Coordinators, and Auto Flush Bolts
  - 4. A156.4-08.....Door Controls (Closers)
  - 5. A156.5-14.....Cylinders and Input Devices for Locks.
  - 6. A156.6-05.....Architectural Door Trim
  - 7. A156.8-05.....Door Controls-Overhead Stops and Holders
  - 8. A156.11-14.....Cabinet Locks
  - 9. A156.12-05 .....Interconnected Locks and Latches
  - 10. A156.13-05.....Mortise Locks and Latches Series 1000
  - 11. A156.14-07 .....Sliding and Folding Door Hardware
  - 12. A156.15-06.....Release Devices-Closer Holder, Electromagnetic and Electromechanical
  - 13. A156.16-08.....Auxiliary Hardware
  - 14. A156.17-04 .....Self-Closing Hinges and Pivots
  - 15. A156.18-06.....Materials and Finishes
  - 16. A156.20-06 .....Strap and Tee Hinges, and Hasps
  - 17. A156.21-09.....Thresholds
  - 18. A156.22-05.....Door Gasketing and Edge Seal Systems
  - 19. A156.23-04.....Electromagnetic Locks
  - 20. A156.24-03.....Delayed Egress Locking Systems
  - 21. A156.25-07 .....Electrified Locking Devices
  - 22. A156.26-06.....Continuous Hinges
  - 23. A156.28-07 .....Master Keying Systems
  - 24. A156.29-07 .....Exit Locks and Alarms
  - 25. A156.30-03 .....High Security Cylinders
  - 26. A156.31-07.....Electric Strikes and Frame Mounted Actuators
  - 27. A156.36-10.....Auxiliary Locks
  - 28. A250.8-03.....Standard Steel Doors and Frames
- D. National Fire Protection Association (NFPA):

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1. 80-10.....Fire Doors and Other Opening Protectives
  2. 101-09.....Life Safety Code
- E. Underwriters Laboratories, Inc. (UL):
1. Building Materials Directory (2008)

## **PART 2 PRODUCTS**

### **2.01 BUTT HINGES**

- A. ANSI A156.1. Provide only three-knuckle hinges, except five-knuckle where the required hinge type is not available in a three-knuckle version (e.g., some types of swing-clear hinges). The following types of butt hinges shall be used for the types of doors listed, except where otherwise specified:
- B. Interior Doors: Type A8112/A5112 for doors 900 mm (3 feet) wide or less and Type A8111/A5111 for doors over 900 mm (3 feet) wide. Hinges for doors exposed to high humidity areas (shower rooms, toilet rooms, kitchens, janitor rooms, etc. shall be of stainless steel material.
- C. Provide quantity and size of hinges per door leaf as follows:
  1. Doors up to 1210 mm (4 feet) high: 2 hinges.
  2. Doors 1210 mm (4 feet) to 2260 mm (7 feet 5 inches) high: 3 hinges minimum.
  3. Doors greater than 2260 mm (7 feet 5 inches) high: 4 hinges.
  4. Doors up to 900 mm (3 feet) wide, standard weight: 114 mm x 114 mm (4-1/2 inches x 4-1/2 inches) hinges.
  5. Doors over 900 mm (3 feet) to 1065 mm (3 feet 6 inches) wide, standard weight: 127 mm x 114 mm (5 inches x 4-1/2 inches).
  6. Doors over 1065 mm (3 feet 6 inches) to 1210 mm (4 feet), heavy weight: 127 mm x 114 mm (5 inches x 4-1/2 inches).
  7. Provide heavy-weight hinges where specified.
    - a. At doors weighing 330 kg (150 pounds) or more, furnish 127 mm (5 inch) high hinges.
- D. See Articles "MISCELLANEOUS HARDWARE" and "HARDWARE SETS" for pivots and hinges other than butts specified above and continuous hinges specified below.

### **2.02 CONTINUOUS HINGES**

- A. ANSI/BHMA A156.26, Grade 1-300.
- B. Listed under Category N in BHMA's "Certified Product Directory."
- C. General: Minimum 0.120-inch- (3.0-mm-) thick, hinge leaves with minimum overall width of 4 inches (102 mm); fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete
- D. Continuous, Barrel-Type Hinges: Hinge with knuckles formed around a Teflon-coated 6.35mm (0.25-inch) minimum diameter pin that extends entire length of hinge.
- E. Base Metal for Interior Hinges: Steel.
- F. Base Metal for Hinges for Fire-Rated Assemblies: Steel.
- G. Provide with non-removable pin (hospital tip option) at lockable outswing doors.
- H. Where required to clear adjacent casing, trim, and wall conditions and allow full door swing, provide wide throw hinges of minimum width required.
- I. Provide with manufacturer's cut-outs for separate mortised power transfers and/or mortised automatic door bottoms where they occur.
- J. Where thru-wire power transfers are integral to the hinge, provide hinge with easily removable portion to allow easy access to wiring connections.

- K. Where models are specified that provide an integral wrap-around edge guard for the hinge edge of the door, provide manufacturer's adjustable threaded stud and machine screw mechanism to allow the door to be adjusted within the wrap-around edge guard.

### **2.03 DOOR CLOSING DEVICES**

- A. Closing devices shall be products of one manufacturer for each type specified.

### **2.04 OVERHEAD CLOSERS**

- A. Conform to ANSI A156.4, Grade 1.
- B. Closers shall conform to the following:
  1. The closer shall have minimum 50 percent adjustable closing force over minimum value for that closer and have adjustable hydraulic back check effective between 60 degrees and 85 degrees of door opening.
  2. Where specified, closer shall have hold-open feature.
  3. Size Requirements: Provide multi-size closers, sizes 1 through 6, except where multi-size closer is not available for the required application.
  4. Material of closer body shall be forged or cast.
  5. Arm and brackets for closers shall be steel, malleable iron or high strength ductile cast iron.
  6. Where closers are exposed to the exterior or are mounted in rooms that experience high humidity, provide closer body and arm assembly of stainless steel material.
  7. Closers shall have full size metal cover; plastic covers will not be accepted.
  8. Closers shall have adjustable hydraulic back-check, separate valves for closing and latching speed, adjustable back-check positioning valve, and adjustable delayed action valve.
  9. Provide closers with any accessories required for the mounting application, including (but not limited to) drop plates, special soffit plates, spacers for heavy-duty parallel arm fifth screws, bull-nose or other regular arm brackets, longer or shorter arm assemblies, and special factory templating. Provide special arms, drop plates, and templating as needed to allow mounting at doors with overhead stops and/or holders.
  10. Closer arms or backcheck valve shall not be used to stop the door from overswing, except in applications where a separate wall, floor, or overhead stop cannot be used.
  11. Provide parallel arm closers with heavy duty rigid arm.
  12. Where closers are to be installed on the push side of the door, provide parallel arm type except where conditions require use of top jamb arm.
  13. Provide all surface closers with the same body attachment screw pattern for ease of replacement and maintenance.
  14. All closers shall have a 1 1/2" (38mm) minimum piston diameter.

### **2.05 DOOR STOPS**

- A. Conform to ANSI A156.16.
- B. Provide door stops wherever an opened door or any item of hardware thereon would strike a wall, column, equipment or other parts of building construction. For concrete, masonry or quarry tile construction, use expansion shields for mounting door stops.
- C. Where cylindrical locks with turn pieces or pushbuttons occur, equip wall bumpers Type L02251 (rubber pads having concave face) to receive turn piece or button.
- D. Provide floor stops (Type L02141 or L02161) in office areas; Type L02121 x 3 screws into floor elsewhere. Wall bumpers, where used, must be installed to impact the trim or the door within the leading half of its width. Floor stops, where used, must be installed within 4-inches of the wall face and impact the door within the leading half of its width.

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- E. Where drywall partitions occur, use floor stops, Type L02141 or L02161 in office areas, Type L02121 elsewhere.
- F. Omit stops where floor mounted door holders are required and where automatic operated doors occur.
- G. Provide appropriate roller bumper for each set of doors (except where closet doors occur) where two doors would interfere with each other in swinging.
- H. Provide appropriate door mounted stop on doors in individual toilets where floor or wall mounted stops cannot be used.
- I. Provide overhead surface applied stop Type C02541, ANSI A156.8 on patient toilet doors in bedrooms where toilet door could come in contact with the bedroom door.
- J. Provide door stops on doors where combination closer magnetic holders are specified, except where wall stops cannot be used or where floor stops cannot be installed within 4-inches of the wall.
- K. Where the specified wall or floor stop cannot be used, provide concealed overhead stops (surface-mounted where concealed cannot be used).

## **2.06 OVERHEAD DOOR STOPS AND HOLDERS**

- A. Conform to ANSI Standard A156.8. Overhead holders shall be of sizes recommended by holder manufacturer for each width of door. Set overhead holders for 110 degree opening, unless limited by building construction or equipment. Provide Grade 1 overhead concealed slide type: stop-only at rated doors and security doors, hold-open type with exposed hold-open on/off control at all other doors requiring overhead door stops.

## **2.07 LOCKS AND LATCHES**

- A. Conform to ANSI A156.2. Locks and latches for doors 45 mm (1-3/4 inch) thick or over shall have beveled fronts. Cylinders for all locksets shall be removable core type. Cylinders shall be furnished with construction removable cores and construction master keys. Cylinder shall be removable by special key or tool. Construct all cores so that they will be interchangeable into the core housings of all mortise locks, rim locks, cylindrical locks, and any other type lock included in the Great Grand Master Key System. Disassembly of lever or lockset shall not be required to remove core from lockset. All locksets or latches on double doors with fire label shall have latch bolt with 19 mm (3/4 inch) throw, unless shorter throw allowed by the door manufacturer's fire label. Provide temporary keying device or construction core to allow opening and closing during construction and prior to the installation of final cores.
- B. In addition to above requirements, locks and latches shall comply with following requirements:
  - 1. Mortise Lock and Latch Sets: Conform to ANSI/BHMA A156.13. Mortise locksets shall be series 1000, minimum Grade 1. All locksets and latchsets, except on designated doors in Psychiatric (Mental Health) areas, shall have lever handles fabricated from cast stainless steel. Furnish lever trim matching facility standard. No substitute lever material shall be accepted. All locks and latchsets shall be furnished with 122.55 mm (4-7/8-inch) curved lip strike and wrought box. At outswing pairs with overlapping astragals, provide flat lip strip with 21mm (7/8-inch) lip-to-center dimension. Lock function F02 shall be furnished with emergency tools/keys for emergency entrance. All lock cases installed on lead lined doors shall be lead lined before applying final hardware finish. Furnish armored fronts for all mortise locks. Where mortise locks are installed in high-humidity locations or where exposed to the exterior on both sides of the opening, provide non-ferrous mortise lock case.
  - 2. Cylindrical Lock and Latch Sets: levers shall meet ADA (Americans with Disabilities Act) requirements. Cylindrical locksets shall be series 4000 Grade I. All locks and latchsets shall be furnished with 122.55 mm (4-7/8-inch) curved lip strike and wrought box. At outswing pairs with overlapping astragals, provide flat lip strip with 21mm (7/8-inch) lip-to-

center dimension. Provide lever design to match design selected by Architect or to match existing lever design. Where two turn pieces are specified for lock F76, turn piece on inside knob shall lock and unlock inside knob, and turn piece on outside knob shall unlock outside knob when inside knob is in the locked position. (This function is intended to allow emergency entry into these rooms without an emergency key or any special tool.)

3. Auxiliary locks shall be as specified under hardware sets and conform to ANSI A156.36.
4. Locks on designated doors in Psychiatric (Mental Health) areas shall be paddle type with arrow projection covers and be UL Listed. Provide these locks with paddle in the down position on both sides of the door. Locks shall be fabricated of wrought stainless steel.

**2.08 PUSH-BUTTON COMBINATION LOCKS**

- A. ANSI/BHMA A156.5, Grade 1. Battery operated pushbutton entry.
- B. Construction: Heavy duty mortise lock housing conforming to ANSI/BHMA A156.13, Grade 1. Lever handles and operating components in compliance with the ABAAS and the ADA Accessibility Guidelines. Match lever handles of locks and latchsets on adjacent doors.
- C. Special Features: Key override to permit a master keyed security system and a pushbutton security code activated passage feature to allow access without using the entry code.

**2.09 KEYS**

- A. Stamp all keys with change number and key set symbol. Furnish keys in quantities as follows:

Locks/Keys	Quantity
A - Master - Mgr / CMO Offices	6 keys each
AA - Interior Doors	30 keys each
AB - Exterior Doors	10 keys each
B - Vestibule	5 keys each
SKD1 - IT Room	5 keys each
SKD2 - Security	5 keys each

**2.10 KEY CABINET**

- A. ANSI Standard A156.11. Provide key cabinet made of cold rolled, 1.2 mm (0.0478 inch) thick furniture steel electro-welded. Doors shall have "no sag" continuous brass-pin piano type hinge and be equipped with chrome plated locking door handles, hook cam and mechanical pushbutton door lock. Key Cabinet and Key Control System shall accommodate all keys for this project plus 25 percent. Provide minimum number of multiple cabinets where a single cabinet of largest size will not accommodate the required number of keys.
- B. Key tags shall consist of two sets: Permanent self-locking and loan key snaphook type with tag colors as follows: Red fiber marker of the permanent self-locking type approximately 32 mm  
 1. (1-1/4 inch) in diameter engraved with the legend "FILE KEY MUST NOT BE LOANED."  
 Also furnish for each hook a white cloverleaf key marker with snap-hooks engraved with the legend "LOAN KEY."
- C. The manufacturer of the lock cylinders and locks shall attach a key tag to keys of each lock cylinder and shall mark thereon the respective item number and key change number. Provide each group of keys in a key gathering envelope (supplied by Key Cabinet Manufacturer) in which the lock manufacturer shall include the following information: Item number, key change number and door number. The contractor shall furnish the Key Cabinet Manufacturer the hardware and keying schedules and change keys.
- D. The Key Cabinet Manufacturer shall set up a three-way cross index system, including master keys, listing the keys alphabetically, the hooks numerically and the key changes numerically on different colored index cards. Index cards shall be typewritten and inserted in a durable binder. Attach the keys to the two sets of numbered tags supplied with the cabinet. (The permanent tag and the loan key tag). Instruct the owner in proper use of the system. Install cabinet as directed



by the COR.

## **2.11 ARMOR PLATES, KICK PLATES, MOP PLATES AND DOOR EDGING**

- A. Conform to ANSI Standard A156.6.
- B. Provide protective plates // and door edging // as specified below:
  - 1. Kick plates, mop plates and armor plates of metal, Type J100 series.
  - 2. Provide kick plates and mop plates where specified. Kick-mop plates shall be 254 mm (5 inches). Both kick and mop plates shall be minimum 1.27 mm (0.050 inches) thick. Provide kick and mop plates beveled on all 4 edges (B4E). On push side of doors where jamb stop extends to floor, make kick plates 38 mm (1-1/2 inches) less than width of door, except pairs of metal doors which shall have plates 25 mm (1 inch) less than width of each door. Extend all other kick and mop plates to within 6 mm (1/4 inch) of each edge of doors. Kick and mop plates shall butt astragals. For jamb stop requirements, see specification sections pertaining to door frames.
  - 3. Kick plates and/or mop plates are not required on following door sides:
    - a. Armor plate side of doors;
    - b. Closet side of closet doors;
    - c. Storage side of doors to or from storage spaces;
    - d. Both sides of entrance doors.
  - 4. Armor plates shall be thickness as noted in the hardware set, 875 mm (35 inches) high and 38 mm (1-1/2 inches) less than width of doors, except on pairs of metal doors. Provide armor plates beveled on all 4 edges (B4E). Plates on pairs of metal doors shall be 25 mm (1 inch) less than width of each door. Where top of intermediate rail of door is less than 875 mm (35 inches) from door bottom, extend armor plates to within 13 mm (1/2 inch) of top of intermediate rail. On doors equipped with panic devices, extend armor plates to within 13 mm (1/2 inch) of panic bolt push bar.
  - 5. Where louver or grille occurs in lower portion of doors, substitute stretcher plate and kick plate in place of armor plate. Size of stretcher plate and kick plate shall be 254 mm (5 inches) high.
  - 6. Provide stainless steel edge guards where so specified at wood doors. Provide mortised type instead of surface type except where door construction and/or ratings will not allow. Provide edge guards of bevel and thickness to match wood door. Provide edge guards with factory cut-outs for door hardware that must be installed through or extend through the edge guard. Provide full-height edge guards except where door rating does not allow; in such cases, provide edge guards to height of bottom of typical lockset armor front. Forward edge guards to wood door manufacturer for factory installation on doors.

## **2.12 EXIT DEVICES**

- A. Conform to ANSI Standard A156.3. Exit devices shall be Grade 1; type and function are specified in hardware sets. Provide flush with finished floor strikes for vertical rod exit devices in interior of building. Trim shall have cast satin stainless steel lever handles of design similar to locksets, unless otherwise specified. Provide key cylinders for keyed operating trim and, where specified, cylinder dogging.
- B. Concealed vertical rod panics shall be provided less bottom rod at interior doors, unless lockable or otherwise specified; provide fire pins as required by exit device and door fire labels.
- C. Where removable mullions are specified at pairs with rim panic devices, provide mullion with key-removable feature.
- D. At non-rated openings with panic hardware, provide panic hardware with key cylinder dogging feature.
- E. Exit devices for fire doors shall comply with Underwriters Laboratories, Inc., requirements for Fire Exit Hardware. Submit proof of compliance.

### **2.13 FLUSH BOLTS (LEVER EXTENSION)**

- A. Conform to ANSI A156.16. Flush bolts shall be Type L24081 unless otherwise specified. Furnish proper dustproof strikes conforming to ANSI A156.16, for flush bolts required on lower part of doors.
- B. Lever extension manual flush bolts shall only be used at non-fire-rated pairs for rooms only accessed by maintenance personnel.
- C. Face plates for cylindrical strikes shall be rectangular and not less than 25 mm by 63 mm (1 inch by 2-1/2 inches).
- D. Friction-fit cylindrical dustproof strikes with circular face plate may be used only where metal thresholds occur.
- E. Provide extension rods for top bolt where door height exceeds 2184 mm (7 feet 2 inches).

### **2.14 FLUSH BOLTS (AUTOMATIC)**

- A. Conform to ANSI A156.3. Dimension of flush bolts shall conform to ANSI A115. Bolts shall conform to Underwriters Laboratories, Inc., requirements for fire door hardware. Flush bolts shall automatically latch and unlatch. Furnish dustproof strikes conforming to ANSI A156.16 for bottom flushbolt. Face plates for dustproof strike shall be rectangular and not less than 38 mm by 90 mm (1-1/2 by 3-1/2 inches).
- B. At interior doors, provide auto flush bolts less bottom bolt, unless otherwise specified, except at wood pairs with fire-rating greater than 20 minutes; provide fire pins as required by auto flush bolt and door fire labels.

### **2.15 DOOR PULLS WITH PLATES**

- A. Conform to ANSI A156.6. Pull Type J401, 152 mm CTC (6 inches CTC) length by 19 mm (3/4 inches) diameter minimum with plate Type J302, 90 mm by 381 mm (3-1/2 inches by 15 inches), unless otherwise specified. Provide pull with projection of 57.2 mm (2 1/4 inches) minimum and a clearance of 38.1 mm (1 1/2 inches) minimum. Cut plates of door pull plate for cylinders, or turn pieces where required.

### **2.16 PUSH PLATES**

- A. Conform to ANSI A156.6. Metal, Type J302, 203 mm (8 inches) wide by 406.4 mm (16 inches) high. Provide metal Type J302 plates 102 mm (4 inches) wide by 406.4 mm (16 inches) high where push plates are specified for doors with stiles less than 203 mm (8 inches) wide. Cut plates for cylinders, and turn pieces where required.

### **2.17 COMBINATION PUSH AND PULL PLATES**

- A. Conform to ANSI 156.6. Type J303, stainless steel 3 mm (1/8 inch) thick, 80 mm (3-1/3 inches) wide by 800 mm (16 inches) high, top and bottom edges shall be rounded. Secure plates to wood doors with 38 mm (1-1/2 inch) long No. 12 wood screws. Cut plates for turn pieces, and cylinders where required. Pull shall be mounted down.

### **2.18 COORDINATORS**

- A. Conform to ANSI A156.16. Coordinators, when specified for fire doors, shall comply with Underwriters Laboratories, Inc., requirements for fire door hardware. Coordinator may be omitted on interior pairs of non-labeled open where open back strike is used. Open back strike shall not be used on labeled doors. Paint coordinators to match door frames, unless coordinators are plated. Provide bar type coordinators, except where gravity coordinators are required at acoustic pairs. For bar type coordinators, provide filler bars for full width and, as required, brackets for push-side surface mounted closers, overhead stops, and vertical rod panic strikes.

## **2.19 THRESHOLDS**

- A. Conform to ANSI A156.21, mill finish extruded aluminum, except as otherwise specified. In existing construction, thresholds shall be installed in a bed of sealant with ¼-20 stainless steel machine screws and expansion shields. In new construction, embed aluminum anchors coated with epoxy in concrete to secure thresholds. Furnish thresholds for the full width of the openings.
- B. At any interior doors exposed to moisture, provide threshold with non-slip abrasive finish.
- C. Provide with miter returns where threshold extends more than 12 mm (0.5 inch) beyond face of frame.

## **2.20 AUTOMATIC DOOR BOTTOM SEAL AND RUBBER GASKET FOR LIGHT PROOF OR SOUND CONTROL DOORS**

- A. Conform to ANSI A156.22. Provide mortise or under-door type, except where not practical. For mortise automatic door bottoms, provide type specific for door construction (wood or metal).

## **2.21 MISCELLANEOUS HARDWARE**

- A. Access Doors (including Sheet Metal, Screen and Woven Wire Mesh Types): Except for fire-rated doors and doors to Temperature Control Cabinets, equip each single or double metal access door with Lock Type E07213, conforming to ANSI A156.11. Key locks as directed. Ship lock prepaid to the door manufacturer. Hinges shall be provided by door manufacturer.
- B. Cylinders for Various Partitions and Doors: Key cylinders same as entrance doors of area in which partitions and door occur, except as otherwise specified. Provide cylinders to operate locking devices where specified for following partitions and doors:
  - 1. Folding doors and partitions.
  - 2. Wicket door (in roll-up door assemblies).
  - 3. Slide-up doors.
  - 4. Swing-up doors.
  - 5. Fire-rated access doors-Engineer's key set.
  - 6. Doors from corridor to electromagnetic shielded room.
  - 7. Day gate on vault door.
- C. Mutes: Conform to ANSI A156.16. Provide door mutes or door silencers Type L03011 or L03021, depending on frame material, of white or light gray color, on each steel or wood door frame, except at fire-rated frames, lead-lined frames and frames for sound-resistant, lightproof and electromagnetically shielded doors. Furnish 3 mutes for single doors and 2 mutes for each pair of doors, except double-acting doors. Provide 4 mutes or silencers for frames for each Dutch type door. Provide 2 mutes for each edge of sliding door which would contact door frame

## **2.22 FINISHES**

- A. Exposed surfaces of hardware shall have ANSI A156.18, finishes as specified below. Finishes on all hinges, pivots, closers, thresholds, etc., shall be as specified below under "Miscellaneous Finishes." For field painting (final coat) of ferrous hardware, see Section 09 91 00, PAINTING.
- B. 626 or 630: All surfaces on interior of buildings, except where other finishes are specified.
- C. Miscellaneous Finishes:
  - 1. Hinges --interior doors: 652 or 630.
  - 2. Pivots: Match door trim.
  - 3. Door Closers: Factory applied paint finish. Dull or Satin Aluminum color.
  - 4. Thresholds: Mill finish aluminum.
  - 5. Cover plates for floor hinges and pivots: 630.
  - 6. Other primed steel hardware: 600.

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- D. Hardware Finishes for Existing Buildings: U.S. Standard finishes shall match finishes of hardware in (similar) existing spaces.
- E. Special Finish: Exposed surfaces of hardware for dark bronze anodized aluminum doors shall have oxidized oil rubbed bronze finish (dark bronze) finish on door closers shall closely match doors.

**2.23 BASE METALS**

- A. Apply specified U.S. Standard finishes on different base metals as following:

Finish	Base Metal
652	Steel
626	Brass or bronze
630	Stainless steel

**PART 3 EXECUTION**

**3.01 HARDWARE HEIGHTS**

- A. For existing buildings locate hardware on doors at heights to match existing hardware. The Contractor shall visit the site, verify location of existing hardware and submit locations to VA COR for approval.
- B. Hardware Heights from Finished Floor:
  1. Exit devices centerline of strike (where applicable) 1024 mm (40-5/16 inches).
  2. Locksets and latch sets centerline of strike 1024 mm (40-5/16 inches).
  3. Deadlocks centerline of strike 1219 mm (48 inches).
  4. Hospital arm pull 1168 mm (46 inches) to centerline of bottom supporting bracket.
  5. Centerline of door pulls to be 1016 mm (40 inches).
  6. Push plates and push-pull shall be 1270 mm (50 inches) to top of plate.
  7. Push-pull latch to be 1024 mm (40-5/16 inches) to centerline of strike.
  8. Locate other hardware at standard commercial heights. Locate push and pull plates to prevent conflict with other hardware.

**3.02 INSTALLATION**

- A. Closer devices, including those with hold-open features, shall be equipped and mounted to provide maximum door opening permitted by building construction or equipment. Closers shall be mounted on side of door inside rooms, inside stairs, and away from corridors except security bedroom, bathroom and anteroom doors which shall have closer installed parallel arm on exterior side of doors. Where closers are mounted on doors they shall be mounted with hex nuts and bolts; foot shall be fastened to frame with machine screws.

- B. Hinge Size Requirements:

Door Thickness	Door Width	Hinge Height
45 mm (1-3/4 inch)	900 mm (3 feet) and less	113 mm (4-1/2 inches)
45 mm (1-3/4 inch)	Over 900 mm (3 feet) but not more than 1200 mm (4 feet)	125 mm (5 inches)
35 mm (1-3/8 inch) (hollow core wood doors)	Not over 1200 mm (4 feet)	113 mm (4-1/2 inches)

- C. Hinge leaves shall be sufficiently wide to allow doors to swing clear of door frame trim and surrounding conditions.
- D. Where new hinges are specified for new doors in existing frames or existing doors in new frames, sizes of new hinges shall match sizes of existing hinges; or, contractor may reuse existing hinges provided hinges are restored to satisfactory operating condition as approved by

COR. Existing hinges shall not be reused on door openings having new doors and new frames. Coordinate preparation for hinge cut-outs and screw-hole locations on doors and frames.

E. Hinges Required Per Door:

Door Description	Number butts
Doors 1500 mm (5 ft) or less in height	2 butts
Doors over 1500 mm (5 ft) high and not over 2280 mm (7 ft 6 in) high	3 butts
Doors over 2280 mm (7 feet 6 inches) high	4 butts
Dutch type doors	4 butts
Doors with spring hinges 1370 mm (4 feet 6 inches) high or less	2 butts
Doors with spring hinges over 1370 mm (4 feet 6 inches)	3 butts

- F. Fastenings: Suitable size and type and shall harmonize with hardware as to material and finish. Provide machine screws and lead expansion shields to secure hardware to concrete, ceramic or quarry floor tile, or solid masonry. Fiber or rawl plugs and adhesives are not permitted. All fastenings exposed to weather shall be of nonferrous metal.
- G. After locks have been installed; show in presence of COR that keys operate their respective locks in accordance with keying requirements. (All keys, Master Key level and above shall be sent Registered Mail to the Medical Center Director along with the bitting list. Also a copy of the invoice shall be sent to the COR for his records.) Installation of locks which do not meet specified keying requirements shall be considered sufficient justification for rejection and replacement of all locks installed on project.

**3.03 FINAL INSPECTION**

- A. Installer to provide letter to VA Resident/Project Engineer that upon completion, installer has visited the Project and has accomplished the following:
1. Re-adjust hardware.
  2. Evaluate maintenance procedures and recommend changes or additions, and instruct VA personnel.
  3. Identify items that have deteriorated or failed.
  4. Submit written report identifying problems.

**3.04 DEMONSTRATION**

- A. Demonstrate efficacy of mechanical hardware and electrical, and electronic hardware systems, including adjustment and maintenance procedures, to satisfaction of Resident/Project Engineer and VA Locksmith.

**3.05 HARDWARE SETS**

- A. As indicated on the Drawings.

**END OF SECTION**

**SECTION 088000  
GLAZING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Glazing units.
- B. Glazing compounds.

**1.02 RELATED REQUIREMENTS**

- A. Section 081113 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.

**1.03 REFERENCE STANDARDS**

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials Current Edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test 2015 (Reaffirmed 2020).
- C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers 2005 (Reapproved 2019).
- D. ASTM C1036 - Standard Specification for Flat Glass 2021.
- E. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.
- F. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass 2021a.
- G. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings 2016.
- H. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation 2019.
- I. GANA (GM) - GANA Glazing Manual 2008.
- J. GANA (SM) - GANA Sealant Manual 2008.
- K. GANA (LGRM) - Laminated Glazing Reference Manual 2009.
- L. ICC (IBC) - International Building Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use 1990 (2016).
- N. ITS (DIR) - Directory of Listed Products Current Edition.
- O. NFRC 100 - Procedure for Determining Fenestration Product U-factors 2020.
- P. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence 2020.
- Q. UL (DIR) - Online Certifications Directory Current Edition.

**1.04 SUBMITTALS**

- A. See Section 013000 Submittals for submittal procedures.
- B. Product Data on Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

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- D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

### 1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), and IGMA TM-3000 for glazing installation methods.

### 1.06 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 40 degrees F (4 degrees C).

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Glass Fabricators:
1. GGI - General Glass International: [www.generalglass.com](http://www.generalglass.com)
  2. JE Berkowitz, LP: [www.jeberkowitz.com](http://www.jeberkowitz.com)
  3. Standard Bent Glass Corp: [www.standardbent.com](http://www.standardbent.com)
  4. Thompson I.G., LLC: [www.thompsonig.com](http://www.thompsonig.com)
  5. Trulite Glass & Aluminum Solutions, LLC: [www.trulite.com](http://www.trulite.com)
  6. Viracon, Inc: [www.viracon.com](http://www.viracon.com)
  7. Substitutions: See Section 016310 - Product Substitutions.

### 2.02 GLASS MATERIALS

- A. Float Glass: Provide float glass based glazing unless otherwise indicated.
1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
  2. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
  3. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
  4. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.

### 2.03 GLAZING UNITS

- A. Monolithic Interior Vision Glazing:
1. Applications: Glazed lites in doors.
  2. Glass Type: Fully tempered safety glass as specified.
  3. Tint: Clear.
  4. Thickness: 1/4 inch (6.4 mm), nominal.

### 2.04 ACCESSORIES

- A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) by width of glazing rabbet space minus 1/16 inch (1.5 mm) by height to suit glazing method and pane weight and area.
- B. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
1. Width: As required for application.
  2. Thickness: As required for application.

## PART 3 EXECUTION

### 3.01 VERIFICATION OF CONDITIONS

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

### **3.02 PREPARATION**

- A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

### **3.03 INSTALLATION, GENERAL**

- A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.
- B. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.
- C. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
- D. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

### **3.04 CLEANING**

- A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- B. Remove nonpermanent labels immediately after glazing installation is complete.
- C. Clean glass and adjacent surfaces after sealants are fully cured.
- D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

### **3.05 PROTECTION**

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.
- B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

**END OF SECTION**



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**SECTION 090561  
COMMON WORK RESULTS FOR FLOORING PREPARATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
  - 1. Resilient tile and sheet.
  - 2. Thin-set ceramic tile and stone tile.
- B. Removal of existing floor coverings.
- C. Patching compound.
- D. Preparation of existing wood-based subfloors for installation of new floor coverings.

**1.02 REFERENCE STANDARDS**

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens) 2021.
- B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters, and Gypsum Concrete 2020.
- C. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings 2011.

**1.03 SUBMITTALS**

- A. Visual Observation Report: For existing floor coverings to be removed.
- B. Adhesive Bond and Compatibility Test Report.
- C. Copy of RFCI (RWP).

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Keep materials from freezing.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
  - 1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
  - 2. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
  - 3. Products:
    - a. ARDEX Engineered Cements; ARDEX Feather Finish: [www.ardexamericas.com](http://www.ardexamericas.com)
    - b. H.B. Fuller Construction Products, Inc; TEC Feather Edge Skim Coat: [www.tecspecialty.com](http://www.tecspecialty.com)
    - c. Substitutions: See Section 016310 - Product Substitutions.

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**PART 3 EXECUTION**

**3.01 REMOVAL OF EXISTING FLOOR COVERINGS**

- A. Comply with local, State, and federal regulations and recommendations of RFCI (RWP), as applicable to floor covering being removed.
- B. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

**3.02 PROTECTION**

- A. Cover prepared floors with building paper or other durable covering.

**END OF SECTION**

**SECTION 092116  
GYPSUM BOARD ASSEMBLIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Performance criteria for gypsum board assemblies.
- B. Metal stud wall framing.
- C. Acoustic insulation.
- D. Gypsum sheathing.
- E. Gypsum wallboard.
- F. Joint treatment and accessories.

**1.02 REFERENCE STANDARDS**

- A. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units 2018.
- B. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board 2017 (Reapproved 2022).
- C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.
- D. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board 2020.
- E. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs 2022.
- F. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base 2019.
- G. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing 2017.
- H. ASTM C1396/C1396M - Standard Specification for Gypsum Board 2017.
- I. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber 2021.
- J. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).
- K. ASTM E413 - Classification for Rating Sound Insulation 2022.
- L. GA-216 - Application and Finishing of Gypsum Panel Products 2021.
- M. GA-600 - Fire Resistance and Sound Control Design Manual 2021.
- N. UL (FRD) - Fire Resistance Directory Current Edition.

**1.03 SUBMITTALS**

- A. See Section 013000 Submittals for submittal procedures.
- B. Product Data: Provide data on gypsum board, accessories, and joint finishing system.
- C. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

**PART 2 PRODUCTS**

**2.01 GYPSUM BOARD ASSEMBLIES**

- A. Provide completed assemblies complying with ASTM C840 and GA-216.

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- B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
  - 1. Acoustic Attenuation: STC as indicated calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- C. Fire-Resistance-Rated Assemblies: Provide completed assemblies with the following characteristics:
  - 1. Gypsum Association File Numbers: Comply with requirements of GA-600 for the particular assembly.
  - 2. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

## 2.02 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
  - 1. Gold Bond Building Products, LLC provided by National Gypsum Company; Soundbreak XP: [www.goldbondbuilding.com](http://www.goldbondbuilding.com)
  - 2. USG Corporation; Fire-Shield: [www.usg.com](http://www.usg.com)
  - 3. Substitutions: See Section 016310 - Product Substitutions.
- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
  - 1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
  - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
    - a. Mold-resistant board is required whenever board is being installed before the building is enclosed and conditioned.
  - 3. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
  - 4. Thickness:
    - a. Vertical Surfaces: 5/8 inch (16 mm).
    - b. Ceilings: 5/8 inch (16 mm).
- C. Backing Board For Wet Areas: One of the following products:
  - 1. Application: Surfaces behind tile in wet areas including tub and shower surrounds and shower ceilings.
- D. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
  - 1. Application: Vertical surfaces behind thinset tile, except in wet areas.
  - 2. Regular Board Thickness: 5/8 inch (16 mm).
  - 3. Edges: Tapered.

## 2.03 GYPSUM BOARD ACCESSORIES

- A. Acoustic Insulation: ASTM C665; preformed mineral-fiber, friction fit type, unfaced; thickness as required for STC.
- B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
  - 1. Products:
    - a. Franklin International, Inc; Titebond GREENchoice Professional Acoustical Smoke and Sound Sealant: [www.titebond.com](http://www.titebond.com)
    - b. Liquid Nails, a brand of PPG Architectural Coatings: [www.liquidnails.com](http://www.liquidnails.com)
    - c. Substitutions: See Section 016310 - Product Substitutions.
- C. Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic, galvanized steel, or rolled zinc, unless noted otherwise.
  - 1. Corner Beads: Low profile, for 90 degree outside corners.

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- a. Products:
  - 1) CertainTeed Corporation; No-Coat Drywall Corner: [www.certainteed.com](http://www.certainteed.com)
  - 2) ClarkDietrich; Strait-Flex Big-Stick: [www.clarkdietrich.com](http://www.clarkdietrich.com)
  - 3) Phillips Manufacturing Co; Everlast Corner Bead: [www.phillipsmfg.com](http://www.phillipsmfg.com)
  - 4) Trim-Tex, Inc: [www.trim-tex.com](http://www.trim-tex.com)
  - 5) Substitutions: See Section 016310 - Product Substitutions.
- 2. L-Trim with Tear-Away Strip: Sized to fit 5/8 inch (16 mm) thick gypsum wallboard.
- 3. Expansion Joints:
  - a. Type: V-shaped PVC with tear away fins.
  - b. Type: V-shaped metal with factory-installed protective tape.
- D. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
  - 1. Paper Tape: 2 inch (50 mm) wide, creased paper tape for joints and corners, except as otherwise indicated.
  - 2. Joint Compound: Drying type, vinyl-based, ready-mixed. (Contractor choice.)
  - 3. Joint Compound: Setting type, field-mixed. (Contractor choice.)
- E. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches (0.84 mm) in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that project conditions are appropriate for work of this section to commence.

#### **3.02 ACOUSTIC ACCESSORIES INSTALLATION**

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
  - 1. Place continuous bead at perimeter of each layer of gypsum board.
  - 2. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

#### **3.03 BOARD INSTALLATION**

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
- C. Double-Layer, Nonrated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.
- D. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- E. Cementitious Backing Board: Install over wood framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.

#### **3.04 INSTALLATION OF TRIM AND ACCESSORIES**

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
  - 1. Not more than 30 feet (10 meters) apart on walls and ceilings over 50 feet (16 meters) long.
- B. Corner Beads: Install at external corners, using longest practical lengths.

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- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

**3.05 JOINT TREATMENT**

- A. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.
- B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
  - 1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
  - 2. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
  - 1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).

**END OF SECTION**

**SECTION 093000  
TILING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Cementitious backer board as tile substrate.
- D. Coated glass mat backer board as tile substrate.
- E. Stone thresholds.
- F. Non-ceramic trim.

**1.02 RELATED REQUIREMENTS**

- A. Section 079200 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.
- B. Section 092116 - Gypsum Board Assemblies: Tile backer board.

**1.03 REFERENCE STANDARDS**

- A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar 2017.
- B. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar 2017.
- C. ANSI A108.1c - Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar 1999 (Reaffirmed 2021).
- D. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship 2019.
- E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesive or Water Cleanable Tile-Setting Epoxy Adhesive 2019.
- F. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar 2021.
- G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy 1999 (Reaffirmed 2019).
- H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout 1999 (Reaffirmed 2019).
- I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout 1999 (Reaffirmed 2019).
- J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework 2017.
- K. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units 2018.
- L. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar 1999 (Reaffirmed 2019).
- M. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone 2005 (Reaffirmed 2021).



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- N. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar 2020.
- O. ANSI A108.20 - American National Standard Specifications for Exterior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs 2020.
- P. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive 2021.
- Q. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar 2019.
- R. ANSI A118.6 - American National Standard Specifications for Standard Cement Grouts for Tile Installation 2019.
- S. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units 2019.
- T. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation 2014 (Reaffirmed 2019).
- U. ANSI A137.1 - American National Standard Specifications for Ceramic Tile 2022.
- V. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products 2018.
- W. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel 2018.
- X. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring 2021.
- Y. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride 2022.
- Z. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation 2021.

#### **1.04 SUBMITTALS**

- A. See Section 013000 Submittals for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Samples: Provide photos of tile samples.

#### **1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.
- B. Installer Qualifications:
  - 1. Company specializing in performing tile installation, with minimum of five years of documented experience.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

#### **1.07 FIELD CONDITIONS**

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature above 50 degrees F (10 degrees C) and below 100 degrees F (38 degrees C) during installation and curing of setting materials.

## **PART 2 PRODUCTS**

### **2.01 TILE**

- A. Manufacturers: All products by the same manufacturer.
  - 1. American Olean Corporation: [www.americanolean.com](http://www.americanolean.com)
  - 2. Dal-Tile Corporation: [www.daltile.com](http://www.daltile.com)
  - 3. Emser Tile, LLC: [www.emser.com](http://www.emser.com)
  - 4. Substitutions: See Section 016310 - Product Substitutions.
- B. Ceramic Mosaic Tile: ANSI A137.1 standard grade.
  - 1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
  - 2. Color(s): As indicated.

### **2.02 TRIM AND ACCESSORIES**

- A. Non-Ceramic Trim: Satin brass anodized extruded aluminum, style and dimensions to suit application, for setting using tile mortar or adhesive.
  - 1. Applications:
    - a. Open edges of wall tile.
    - b. Open edges of floor tile.
    - c. Wall corners, outside and inside.
    - d. Transition between floor finishes of different heights.
    - e. Thresholds at door openings.
    - f. Borders and other trim as indicated on drawings.
  - 2. Manufacturers:
    - a. Schluter-Systems: [www.schluter.com](http://www.schluter.com)
    - b. Genesis APS International: [www.genesis-aps.com](http://www.genesis-aps.com)
    - c. Substitutions: See Section 016310 - Product Substitutions.

### **2.03 SETTING MATERIALS**

- A. Manufacturers:
  - 1. ARDEX Engineered Cements: [www.ardexamericas.com](http://www.ardexamericas.com)
  - 2. Custom Building Products: [www.custombuildingproducts.com](http://www.custombuildingproducts.com)
  - 3. LATICRETE International, Inc: [www.laticrete.com](http://www.laticrete.com)
  - 4. Merkrete, by Parex USA, Inc: [www.merkrete.com](http://www.merkrete.com)
  - 5. Substitutions: See Section 016310 - Product Substitutions.
- B. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4.
  - 1. Applications: Use this type of bond coat where indicated, and where no other type of bond coat is indicated.

### **2.04 GROUTS**

- A. Manufacturers:
  - 1. ARDEX Engineered Cements: [www.ardexamericas.com](http://www.ardexamericas.com)
  - 2. Custom Building Products: [www.custombuildingproducts.com](http://www.custombuildingproducts.com)
  - 3. LATICRETE International, Inc; LATICRETE PERMACOLOR Grout: [www.laticrete.com](http://www.laticrete.com)
  - 4. Merkrete, by Parex USA, Inc; Merkrete Duracolor Non-Sanded Color Grout: [www.merkrete.com](http://www.merkrete.com)
  - 5. Substitutions: See Section 016310 - Product Substitutions.
- B. Standard Grout: ANSI A118.6 standard cement grout.
  - 1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
  - 2. Use sanded grout for joints 1/8 inch (3.2 mm) wide and larger; use unsanded grout for joints less than 1/8 inch (3.2 mm) wide.

3. Color(s): As indicated.

## **2.05 MAINTENANCE MATERIALS**

- A. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
  1. Applications: Between tile and plumbing fixtures.
  2. Color(s): As indicated on drawings.
- B. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
  1. Composition: Water-based colorless silicone.

## **2.06 ACCESSORY MATERIALS**

- A. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 5/8 inch (16 mm) thick; 2 inch (51 mm) wide coated glass fiber tape for joints and corners.
- B. Backer Board: Coated glass mat type complying with ASTM C1178/C1178M; inorganic fiberglass mat on both surfaces and integral acrylic coating vapor retarder.
  1. Standard Type: Thickness 5/8 inch (15.9 mm).
- C. Mesh Tape: 2 inch (50 mm) wide self-adhesive fiberglass mesh tape.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.

### **3.02 PREPARATION**

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.
- E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

### **3.03 INSTALLATION - GENERAL**

- A. Install tile and thresholds and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.20, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square and external angles bullnosed.

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- F. Install non-ceramic trim in accordance with manufacturer's instructions.
- G. Sound tile after setting. Replace hollow sounding units.
- H. Keep control and expansion joints free of mortar, grout, and adhesive.
- I. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- J. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
- K. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

**3.04 INSTALLATION - FLOORS - THIN-SET METHODS**

- A. Over wood substrates, install in accordance with TCNA (HB) Method F142, with standard grout, unless otherwise indicated.

**3.05 INSTALLATION - WALL TILE**

- A. Over cementitious backer units install in accordance with TCNA (HB) Method W223, organic adhesive.
- B. Over coated glass mat backer board on studs, install in accordance with TCNA (HB) Method W245.
- C. Over gypsum wallboard on wood studs install in accordance with TCNA (HB) Method W243, thin-set with dry-set or latex-Portland cement bond coat, unless otherwise indicated.

**3.06 CLEANING**

- A. Clean tile and grout surfaces.

**3.07 PROTECTION**

- A. Do not permit traffic over finished floor surface for 4 days after installation.

**3.08 SCHEDULE**

- A. T-1
  - 1. Tile: Ceramic
    - a. Product: Stone Peak
    - b. Style: USG 1224163
    - c. Color: Simply Gray
    - d. Size: 12" x 24"
    - e. Install Pattern: Running Bond
    - f. Location: Restrooms - Floors
    - g. Grout: Mapei #27 Silver
- B. T-2
  - 1. Tile: Ceramic
    - a. Product: Crossville
    - b. Style: Shades SHD41.10624UPS
    - c. Color: Frost
    - d. Size: 3" x 6"
    - e. Install Pattern: Running Bond
    - f. Location: Restrooms - Walls
    - g. Grout: Mapei #77 Frost
- C. SCH-1
  - 1. Trim
    - a. Product: Schluter FINEC - Aluminum
    - b. Location: Restrooms

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- D. SCH-2
  - 1. Coved Base
    - a. Product: Schluter DILEX-AHK, Aluminum
    - b. Location: Restrooms
- E. TRN-1
  - 1. Floor Transition Strip
    - a. Product: Schluter RENO-U
    - b. Finish: Aluminum
    - c. Location: LVT to Tile

**END OF SECTION**

**SECTION 095100  
ACOUSTICAL CEILINGS**

**PART 1 – GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to Work of this Section.

**1.02 DESCRIPTION OF WORK**

- A. Extent of acoustical ceiling tile is shown on Drawing.

**1.03 QUALITY ASSURANCE**

- A. Material as herein specified based on Armstrong Products, printed Specifications and installation. Other manufacturers, as approved. Modifications only as specified are herein approved.

**PART 2 – PRODUCTS**

**2.01 MATERIALS**

- A. Acoustical Tiles/Panels:
  - 1. USG Mars, High NRC/High CAC, #86345 –24" X 24", 1" thick, NRC: .80, CAC: 40, Class A
  - 2. Location: All areas designated as suspended acoustic ceiling.
  - 3. Suspension: Wire suspended, exposed "T" white, 15/16".
  - 4. Attachment Devices: Size for five (5) times design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated.
  - 5. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper.
  - 6. Gauge: Provide wire sized so that stress at three (3) times hanger design load (ASTM C 635, Table 1 Direct Hung) will be less than yield stress of wire but provide not less than 0.106 inch diameter (12 gauge).
  - 7. Edge Moldings and Trim: Provide manufacturer's moldings for edges and penetrations of ceiling that fit with type of edge detail and suspension system indicated.
- B. Acoustical Panel Canopies: Glass fiber panels suspended by hanger wire or rods attached to anchor points on panel back.
  - 1. Size and Configuration: 74-1/2" x 46-1/2"
  - 2. Thickness: 1-1/2 inches
  - 3. Color: White
  - 4. Location: Team Work Areas
  - 5. Products:
    - a. Armstrong World Industries, Inc: [www.armstrongceilings.com](http://www.armstrongceilings.com)
    - b. USG Corporation: Halcyon Canopies: [www.usg.com/ceilings](http://www.usg.com/ceilings)
    - c. Pinta Acoustic: [www.pinta-acoustic.com](http://www.pinta-acoustic.com)
    - d. Substitutions: See Section 016310 - Product Substitutions.

**PART 3 – EXECUTION**

**3.01 INSTALLATION**

- A. General: Install acoustical ceiling systems to comply with installation standard below per manufacturer's instructions and CISCA "Ceiling Systems Handbook".
  - 1. Standards for Installation of Ceiling Suspension Systems: Comply with ASTM C 636 and ASTM E 5880 and current Building Code requirements, using the most restrictive requirements.
- B. Suspend ceiling hangers from building structural members as follows:
  - 1. Install hangers plumb and free from contact with objects with ceiling plenum.

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2. Secure wire hangers by looping and wire tying, either directly to structures or to inserts, eye screws or other devices that are secure and appropriate for substrate.
  3. Space hangers not more than 4'0" o.c. along each member supported directly from hangers, unless otherwise shown, and provide hangers not more than eight (8) inches from ends of each member.
- C. Install seismic wires and ties as detailed.
- D. Install edge molding of type indicated at perimeter of acoustical ceiling area and at locations where necessary to conceal edges of acoustical units.
1. Screw attach molding to substrate at intervals not over 16 inches o.c. and not more than three (3) inches from ends, leveling with ceiling suspension system to tolerance of  $\frac{1}{8}$ " in 12' 0". Miter corners accurately and connect securely.
- E. Coordinate hanger spacing with Mechanical and Electrical Subcontractors and all other related trades.
- F. All runs straight, align with room walls and center as shown on Drawings. Consult with Architect for border conditions with less than six (6) inches between edge trim and exposed "T" hanger before proceeding past layout stage.
- G. Prevent damage or smears on face of tile.
- H. Scribe true and tight where tile articulates with other materials.
- I. Align hangers and clips to obtain a true flush finish. Joints as unnoticeable as possible.
- J. Where gaps occur at grid and wall, seal with acoustical caulk.
- K. Furnish to Owner three (3) unopened boxes of tile at completion of job.

**END OF SECTION**

**SECTION 096500  
RESILIENT FLOORING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Resilient sheet flooring.
- B. Resilient tile flooring.
- C. Static control resilient tile flooring.
- D. Resilient base.
- E. Installation accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 090561 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.

**1.03 REFERENCE STANDARDS**

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source 2019a, with Editorial Revision (2020).
- B. ASTM F970 - Standard Test Method for Measuring Recovery Properties of Floor Coverings after Static Loading 2017.
- C. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile 2004 (Reapproved 2018).
- D. ASTM F1859 - Standard Specification for Rubber Sheet Floor Covering Without Backing 2021a.
- E. ASTM F1861 - Standard Specification for Resilient Wall Base 2021.
- F. ASTM F1913 - Standard Specification for Vinyl Sheet Floor Covering Without Backing 2019.
- G. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source 2023.

**1.04 SUBMITTALS**

- A. See Section 013000 Submittals for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Shop Drawings: Indicate seaming plans and floor patterns.
- D. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
- E. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 degrees F (13 degrees C) and 90 degrees F (72 degrees C).
- D. Protect roll materials from damage by storing on end.



## 1.06 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F (21 degrees C) to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F (13 degrees C).

## PART 2 PRODUCTS

### 2.01 SHEET FLOORING

- A. Vinyl Sheet Flooring: Homogeneous without backing, with color and pattern throughout full thickness.
1. Manufacturers: See Schedule below.
    - a. Armstrong Flooring; Accolade Plus: [www.armstrongflooring.com](http://www.armstrongflooring.com)
    - b. Gerflor USA, Inc; Mipolam Affinity: [www.gerflorusa.com](http://www.gerflorusa.com)
    - c. Shannon Specialty Floors, Inc; TEKNOFLOR Medscapes HPD: [www.shannonspecialtyfloors.com](http://www.shannonspecialtyfloors.com)
    - d. Substitutions: See Section 016310 - Product Substitutions.
- B. Features:
1. Minimum Requirements: Comply with ASTM F1913.
  2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
  3. Sheet Width: 49 inch (1250 mm) minimum.
  4. Static Load Resistance: 250 psi (1725 kPa) minimum, when tested as specified in ASTM F970.
  5. Seams: Heat welded.
- C. Welding Rod: Solid bead in material compatible with flooring, produced by flooring manufacturer for heat welding seams, and in color matching field color.

### 2.02 TILE FLOORING

- A. Vinyl Composition Tile: Homogeneous, with color extending throughout thickness.
1. Manufacturers: See Schedule below.
    - a. Armstrong Flooring; Excelon SDT: [www.armstrongflooring.com](http://www.armstrongflooring.com)
    - b. Johnsonite, a Tarkett Company: [www.johnsonite.com](http://www.johnsonite.com)
    - c. Substitutions: See Section 016000 - Product Requirements.
  2. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.
  3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
  4. Size: 12 by 12 inch (305 by 305 mm).

### 2.03 RESILIENT BASE

- A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; style as scheduled.
1. Height: 4 inch (100 mm).
  2. Thickness: 0.125 inch (3.2 mm).
  3. Finish: Satin.

### 2.04 ACCESSORIES

- A. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
- B. Moldings, Transition and Edge Strips: Same material as flooring.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

### **3.02 PREPARATION**

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

### **3.03 INSTALLATION - GENERAL**

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- D. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
  - 1. Resilient Strips: Attach to substrate using adhesive.

### **3.04 INSTALLATION - SHEET FLOORING**

- A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.
- B. Seal seams by heat welding where indicated.

### **3.05 INSTALLATION - RESILIENT BASE**

- A. Job-formed corners following manufacturer's instructions.

### **3.06 CLEANING**

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

### **3.07 PROTECTION**

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

### **3.08 SCHEDULE**

- A. LVT-1:
  - 1. Type: Luxury Vinyl Plank
    - a. Product: Patcraft
    - b. Style: Timber Grove II 5MM
    - c. Color: Juniper 00559
    - d. Size: 6" x 48"
    - e. Install Pattern: 1/3 Drop
    - f. Location: See Finish Plan for locations.
- B. LVT-2:
  - 1. Type: Luxury Vinyl Plank
    - a. Product: J&J Flooring
    - b. Style: Framework V5001
    - c. Color: Beam 1015
    - d. Size: 9" x 48"
    - e. Install Pattern: 1/3 Drop
    - f. Location: See Finish Plan for locations.

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- C. LVT-3:
  - 1. Type: Luxury Vinyl Plank
    - a. Product: J&J Flooring
    - b. Style: Tatami V5003
    - c. Color: Kyoto 1018
    - d. Size: 18" x 36"
    - e. Install Pattern: Parquet
    - f. Location: See Finish Plan for locations.
- D. SV-1:
  - 1. Type: Sheet Vinyl
    - a. Product: Geflor
    - b. Style: Taralay Impression 0719
    - c. Color: Infinity Lichen
    - d. Size: 82' x 6'66"
    - e. Welding Rod: 05850109
    - f. Location: See Finish Plan for locations.
- E. VCT-1:
  - 1. Type: Vinyl Composition Tile
    - a. Product: Armstrong
    - b. Style: Standard Excelon 51908
    - c. Color: Pewter
    - d. Size: 12" x 12"
    - e. Location: See Finish Plan for locations.
- F. VCT-2:
  - 1. Type: Vinyl Composition Tile - Static Dissipative
    - a. Product: Armstrong
    - b. Style: Excelon STD 51956
    - c. Color: Fossil Gray
    - d. Size: 12" x 12"
    - e. Location: See Finish Plan for locations.
- G. RB-1:
  - 1. Type: Vinyl Base
    - a. Product: Flexco
    - b. Color: 093 Graphite
    - c. Location: See Finish Plan for locations.

**END OF SECTION**

**SECTION 096813  
TILE CARPETING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Walk-off carpet.

**1.02 RELATED REQUIREMENTS**

- A. Section 090561 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.

**1.03 REFERENCE STANDARDS**

- A. CRI 104 - Standard for Installation of Commercial Carpet 2015.
- B. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source 2023.

**1.04 SUBMITTALS**

- A. See Section 013000 Submittals for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- C. Samples: Submit two carpet tiles illustrating color for each carpet color selected.
- D. Manufacturer's Installation Instructions.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Tile Carpeting:
  - 1. Interface, Inc: [www.interface.com](http://www.interface.com)
  - 2. Mannington Commercial: [www.manningtoncommercial.com](http://www.manningtoncommercial.com)
  - 3. Milliken & Company: [www.milliken.com](http://www.milliken.com)
  - 4. Mohawk Group: [www.mohawkgroup.com](http://www.mohawkgroup.com)
  - 5. Substitutions: See Section 016310 - Product Substitutions.

**2.02 SCHEDULE**

- A. Walk-off carpeting:
  - 1. CPT-1
    - a. Product: Patcraft
    - b. Style: Paseo I0316
    - c. Color: Obsidian 00595
    - d. Size: 24" x 24"
    - e. Install Pattern: Brick
    - f. Location: Vestibules

**2.03 ACCESSORIES**

- A. Subfloor Filler: Type recommended by flooring material manufacturer.
- B. Edge Strips: Schluter, Reno, Stainless Steel
- C. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

**3.02 PREPARATION**

- A. Prepare floor substrates for installation of flooring in accordance with Section 090561.

**3.03 INSTALLATION**

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions.
- C. Blend carpet from different cartons to ensure minimal variation in color match.
- D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- E. Lay carpet tile in brick pattern, with pile direction parallel to next unit, set parallel to building lines.
- F. Locate change of color or pattern between rooms under door centerline.
- G. Fully adhere carpet tile to substrate.
- H. Trim carpet tile neatly at walls and around interruptions.
- I. Complete installation of edge strips, concealing exposed edges.

**3.04 CLEANING**

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.

**END OF SECTION**

**SECTION 097200  
WALL COVERINGS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Surface preparation.
- B. Wall covering and borders.

**1.02 REFERENCE STANDARDS**

- A. ASTM D1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Coating Systems 2020.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.
- C. ASTM F793/F793M - Standard Classification of Wall Coverings by Use Characteristics 2020.

**1.03 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on wall covering and adhesive.
- C. Samples: Submit two samples of wall covering, [12 by 12] inch ([ ] mm) in size illustrating color, finish, and texture.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Inspect roll materials at arrival on site, to verify acceptability.
- B. Protect packaged adhesive from temperature cycling and cold temperatures.
- C. Do not store roll goods on end.

**1.06 FIELD CONDITIONS**

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the adhesive or wall covering product manufacturer.
- B. Maintain these conditions 24 hours before, during, and after installation of adhesive and wall covering.

**PART 2 PRODUCTS**

**2.01 WALL COVERINGS**

- A. General Requirements:
  - 1. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.
  - 2. Chemical and Stain Resistance: No visible staining or discoloration and no damage to surface texture when tested in accordance with ASTM D1308.

**2.02 MANUFACTURERS**

- A. Wall Covering:
  - 1. Manufacturers:
    - a. Wolf-Gordon; [www.wolfgordon.com](http://www.wolfgordon.com)
    - b. Koroseal/RJF International: [www.koroseal.com](http://www.koroseal.com)
    - c. MDC Interior Solutions: [www.mdcwall.com](http://www.mdcwall.com)
    - d. Substitutions: See Section 016310 - Product Substitutions.

- B. Substrate Filler: As recommended by adhesive and wall covering manufacturers; compatible with substrate.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that substrate surfaces are prime painted and ready to receive work, and comply with requirements of wall covering manufacturer.
- B. Measure moisture content of surfaces using an electronic moisture meter. Do not apply wall coverings if moisture content of substrate exceeds level recommended by wall covering manufacturer.
- C. Verify flatness tolerance of surfaces does not vary more than 1/8 inch in 10 feet (3 mm in 3 m) nor vary at a rate greater than 1/16 inch/ft (1.5 mm/300 mm).

#### **3.02 PREPARATION**

- A. Fill cracks in substrate and smooth irregularities with filler; sand smooth.
- B. Wash impervious surfaces with tetra-sodium phosphate, rinse and neutralize; wipe dry.
- C. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- D. Vacuum clean surfaces free of loose particles.

#### **3.03 INSTALLATION**

- A. Apply adhesive and wall covering in accordance with manufacturer's instructions.
- B. Apply adhesive to wall surface immediately prior to application of wall covering.
- C. Do not seam within 2 inches (50 mm) of internal corners or within 6 inches (150 mm) of external corners.
- D. Remove excess adhesive while wet from seam before proceeding to next wall covering sheet. Wipe clean with dry cloth.

#### **3.04 CLEANING**

- A. Clean wall coverings of excess adhesive, dust, dirt, and other contaminants.
- B. Reinstall wall plates and accessories removed prior to work of this section.

#### **3.05 PROTECTION**

- A. Do not permit construction activities at or near finished wall covering areas.

#### **3.06 SCHEDULES**

- A. VWC-1:
  - 1. Product: Wolf Gordon
  - 2. Style: Leicester LEI 8-3535
  - 3. Color: Swansdown, 52/54", 20 oz.
  - 4. Location: See Finish Wall Plan for locations.
- B. VWC-2:
  - 1. Product: Wolf Gordon
  - 2. Style: Brooklyn BLN2265
  - 3. Color: Midwood, 52/54", 20oz.
  - 4. Location: See Finish Wall Plan for locations.
  - 5. Notes: Special Pricing #GOH32443485

**END OF SECTION**

**SECTION 097500  
STONE FACING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Stacked stone veneer at interior walls.

**1.02 SUBMITTALS**

- A. See Section 013000 Submittals for submittal procedures.
- B. Product Data: Provide data for stone units, anchor accessories, adhesives, grout, mortar, and reinforcement.
- C. Samples: Submit two stone samples of each stone type, indicating minimum and maximum stone sizes, color range, texture, and markings.

**1.03 DELIVERY, STORAGE, AND HANDLING**

- A. Protect stone from discoloration during storage on site.
- B. Provide ventilation to prevent condensation from forming on stone.
- C. Store stone off the ground and under cover. Store stone panels vertically on edge, resting weight on panel edge.
- D. Protect materials during handling and installation to prevent damage or contamination.
- E. Store dry materials off ground and under shelter from water.
- F. Store liquid materials off ground and covered.
- G. Protect liquid materials from freezing.

**1.04 FIELD CONDITIONS**

- A. Maintain ambient air between 50 to 90 degrees F (10 to 32 degrees C) prior to, during, and for 48 hours after completion of work.

**PART 2 PRODUCTS**

**2.01 STONE**

- A. Products:
  - 1. Indiana Limestone Company: [www.indianalimestonecompany.com](http://www.indianalimestonecompany.com)
  - 2. Mezger Enterprises Ltd: [www.mezger.com](http://www.mezger.com)
  - 3. Vetter Stone: [www.vetterstone.com](http://www.vetterstone.com)
  - 4. Substitutions: See Section 016310 Product Substitutions

**2.02 STONE ANCHORS AND ATTACHMENTS**

- A. Provide anchors and attachments of type and size required to support stonework.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that support work and site conditions are ready to receive work of this section.

**3.02 SCHEDULE**

- A. STN-1
  - 1. Stone Veneer
    - a. Product: Daltile
    - b. Style: Stacked Stone S701
    - c. Color: Macau Black



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d. Location: Check-In / Check-Out (103) & Lab Check-In

**END OF SECTION**

**SECTION 099123  
INTERIOR PAINTING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
  - 1. Mechanical and Electrical:
    - a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
    - b. Paint interior surfaces of air ducts and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
- D. Do Not Paint or Finish the Following Items:
  - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
  - 2. Items indicated to receive other finishes.
  - 3. Items indicated to remain unfinished.
  - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
  - 5. Floors, unless specifically indicated.
  - 6. Glass.
  - 7. Concealed pipes, ducts, and conduits.

**1.02 RELATED REQUIREMENTS**

- A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 055000 - Metal Fabrications: Shop-primed items.

**1.03 REFERENCE STANDARDS**

- A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications 2019.
- B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials 2020.
- C. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association Current Edition.
- D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual Current Edition.
- E. SSPC-SP 1 - Solvent Cleaning 2015, with Editorial Revision (2016).
- F. SSPC-SP 6 - Commercial Blast Cleaning 2007.

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
  - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").

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2. MPI product number (e.g., MPI #47).
  3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.
1. Where sheen is specified, submit samples in only that sheen.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

#### **1.06 FIELD CONDITIONS**

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
  1. Substitution of MPI-approved products by a different manufacturer is preferred over substitution of unapproved products by the same manufacturer.
- B. Paints:
  1. Base Manufacturer: Sherwin Williams.
  2. Benjamin Moore
  3. Behr Process Corporation: [www.behr.com](http://www.behr.com)
  4. Diamond Vogel Paints: [www.diamondvogel.com](http://www.diamondvogel.com)
- C. Primer Sealers: Same manufacturer as top coats.
- D. Substitutions: See Section 016310 Product Substitutions

#### **2.02 PAINTS AND FINISHES - GENERAL**

- A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
  1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at [www.paintinfo.com](http://www.paintinfo.com), for specified MPI categories, except as otherwise indicated.
  2. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
  3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
  4. Supply each paint material in quantity required to complete entire project's work from a single production run.
  5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

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- B. Volatile Organic Compound (VOC) Content: Comply with Section 016116.
- C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- D. Colors: As indicated in Color Schedule.
  - 1. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling under which they are mounted.

### **2.03 ACCESSORY MATERIALS**

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
  - 1. Gypsum Wallboard: 12 percent.
  - 2. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

### **3.02 PREPARATION**

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- F. Galvanized Surfaces:
  - 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- G. Ferrous Metal:
  - 1. Solvent clean according to SSPC-SP 1.
  - 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
  - 3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.
- H. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.

### **3.03 APPLICATION**

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

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- B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- E. Sand wood and metal surfaces lightly between coats to achieve required finish.
- F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- G. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

### 3.04 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

### 3.05 PROTECTION

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

### 3.06 COLOR SCHEDULE

- A. PNT-1:
  - 1. Application: General
  - 2. Sherwin Williams: SW7015
  - 3. Color: Repose Gray
  - 4. Finish: Eggshell
- B. PNT-2:
  - 1. Application: Accent
  - 2. Sherwin Williams: SW7664
  - 3. Color: Steely Gray
  - 4. Finish: Eggshell
  - 5. Location: See Wall Finish Plan for locations.
- C. PNT-3:
  - 1. Application: Accent
  - 2. Sherwin Williams: SW7018
  - 3. Color: Dovetail
  - 4. Finish: Eggshell
  - 5. Location: See Wall Finish Plan for locations.
- D. PNT-4:
  - 1. Application: Door Frames
  - 2. Sherwin Williams: SW7068
  - 3. Color: Grizzle Gray
  - 4. Finish: Semi-gloss
- E. PNT-5:
  - 1. Application: Underside of gypsum board ceilings and headers.
  - 2. Sherwin Williams: SW7005
  - 3. Color: Pure White
  - 4. Finish: Eggshell

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5. Location: See Reflected Ceiling Plan for locations.

**END OF SECTION**

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**SECTION 101400  
SIGNAGE**

**SUMMARY**

**1.01 SECTION INCLUDES:**

- A. All primary and secondary directories, directionals, room identification, workstation ID's and signage for ADA and life safety code compliance.

**1.02 RELATED SECTIONS:**

- A. Division 1: Administrative, procedural and temporary work requirements.

**1.03 REFERENCES**

- A. Signs and their installation shall comply with applicable provisions of the latest edition of the following standards and with requirements of authorities having jurisdiction:
  1. ADAAG – Americans with Disabilities Act Accessibility Guidelines; US Architectural and Transportation Barriers Compliance Board.
  2. International Code Council/American National Standards Institute A117.1-Standard on Accessible and Usable Buildings Facilities.
  3. National Fire Protection Association 101 Life Safety Code.

**1.04 SUBMITTALS**

- A. Submittals for Review:
  1. Signage schedule in manufacturer's format for verification of text/copy.
  2. Approval drawings showing materials, construction detail, lay-out, copy, size and mounting methods.
  3. Engineering drawings for each sign type.
  4. Photos of two sign types for verification of materials, color, pattern, overall quality, and for adherence to drawings and requirements indicated.

**1.05 QUALIFICATIONS**

- A. Manufacturer specializing in manufacturing the products specified in this section with minimum five years experience. Obtain signs from one source and a single manufacturer.

**1.06 WARRANTY**

- A. Provide manufacturer's warranty against defects in materials and workmanship for minimum 5 years.

**PART 2 PRODUCTS**

**2.01 MANUFACTURER**

- A. Signage shall be Fusion as manufactured by Takeform, 1.800.528.1398, [www.takeform.net](http://www.takeform.net) or Architect approved equal.
- B. Substitutions: Not permitted.

**2.02 SIGN STANDARDS**

- A. It is the intent of these specifications to establish a sign standard for the Owner including but not limited to primary and secondary directories, wall mounted and overhead directionals, flag mounted directionals, primary room identification, restrooms, conference room, work station ID's and all code compliant signage. While the Owner may not obtain all signs and sign types, the signage contractor shall design and submit approval drawings for all.
- B. Engineered and Tested:
  1. The signage system shall have undergone rigorous testing to ensure longevity and optimal performance. Testing shall include environmental testing to ensure that materials can withstand changes in temperature and humidity without distortion as well as testing to



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ensure resistance to chemicals and UV effects. Further, mechanical testing shall ensure  
a. that the tensile and pull-out strength of mounting hardware is adequate to ensure a safe installation. Test data shall be included with submittals.

- C. Typography:
  - 1. Type style: see drawings. Copy shall be a true, clean, accurate reproduction of typeface(s) specified. Upper and lower case or all caps shall be as indicated in Sign Type drawings and Signage Schedule. Letter spacing to be normal and interline spacing shall be set by manufacturer.
  - 2. Arrows, symbols and logo art: To be provided in style, sizes, colors and spacing as shown in drawings.
  - 3. Grade II Braille utilizing perfectly round, clear insertion beads.
- D. Evacuation Maps:
  - 1. Evacuation maps shall have a unique "you-are-here" orientation as well as two emergency egress paths. The maps shall show location of fire extinguishers, fire pulls and restrooms.
- E. Color and Finishes:
  - 1. Colors, patterns and artwork: see drawings.
  - 2. Message Background: see drawings.
  - 3. Finishes are to meet current federal ADA and all state and local requirements.

## 2.03 SIGNS

- A. Signage System:
  - 1. The signage shall incorporate a decorative laminate face with applied graphics including all tactile requirements in adherence to ADA specifications.
  - 2. All signs, including work station and room ID's, overheads and flag mounts, directionals and directories shall have a matching appearance and constructed utilizing the same manufacturing process to ensure a consistent look throughout.
- B. Materials:
  - 1. Sign face shall be 0.035" (nominal) standard grade, high pressure surface laminate. A painted sign face shall not be acceptable.
  - 2. The sign shall incorporate balanced construction with the core sandwiched between laminates to prevent warping. Laminate on the sign face only shall not be acceptable.
  - 3. Tactile lettering shall be precision machined, raised 1/32", matte PETG and subsurface colored for scratch resistance.
  - 4. Signs shall incorporate a metal accent bar. Bars shall be anodized with a brushed satin finish. Painted bars shall not be acceptable. Refer to drawings.
- C. Standard Colors:
  - 1. Face/background color shall be standard grade, high pressure laminate, all colors and finishes. Refer to drawings.
  - 2. Standard tactile colors shall match manufacturer's ADA standard color selection. Refer to drawings.
- D. Construction:
  - 1. The signage shall, with the exception of directories and directionals, be a uniform 8 1/2" width to facilitate inserts printed on standard width paper.
  - 2. Insert components shall have a .080 thickness non-glare acrylic window and shall be inlaid flush to sign face for a smooth, seamless appearance.
  - 3. The signage shall include modules allowing for inserts, notice holders, occupancy sliders, marker, magnetic, and cork boards. All modules shall be flush to sign face for a smooth, seamless appearance.
  - 4. The laminates (front and back) shall be pressure laminated and precision machined together to a 90-degree angle. Edges shall be smooth, void of chips, burrs, sharp edges

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and marks.

5. The signage shall utilize an acrylic sphere for Grade II Braille inserted directly into a scratch resistant, high pressure laminate sign face. Braille dots are to be pressure fit in high tolerance drilled holes.
  6. Braille dots shall be half hemispherical domed and protruding a minimum 0.025".
  7. The signage shall utilize a pressure activated adhesive. The adhesive shall be nonhazardous and shall allow for flexing and deflection of the adhered components due to changes in temperature and moisture without bond failure.
  8. All signs shall be provided with appropriate mounting hardware. Hardware shall be finished and architectural in appearance and suitable for the mounting surface.
  9. Some signs may be installed on glass. A blank backer is required to be placed on the opposite side of the glass to cover tape and adhesive. The backer shall match the sign in size and shape.
- E. Printed Inserts:
1. The signage shall be capable of accepting paper or acetate inserts to allow changing and updating as required. Insert components shall have a 0.080" thickness non-glare acrylic window and shall be inlaid flush to sign face for a smooth, seamless appearance.
  2. The signage contractor shall provide and install all signage inserts.
  3. Manufacturer shall provide a template containing layout, font, color, artwork and trim lines to allow Owner to produce inserts on laser or ink jet printer. The template shall be in an Acrobat or Word format (.pdf).
- F. Quantities:
1. Code and Facility Signage:
    - a. Sign Type A - Directory
    - b. Sign Type B - Directional
    - c. Sign Type C - Overhead
    - d. Sign Type D - Evacuation Map
    - e. Sign Type E - Stairs
    - f. Sign Type E.2 - Restroom
    - g. Sign Type E.3 - Misc. Room ID
    - h. Sign Type F - Small Room ID
    - i. Sign Type G - Medium Room ID
    - j. Sign Type G.2 - Large Room ID
    - k. Sign Type H - Room ID Changeable Insert
    - l. Sign Type I - Room ID Changeable Insert
    - m. Sign Type J - Conference Room
    - n. Sign Type L - Workstation ID
    - o. Sign Type M - Flag Mount
    - p. Sign Type N - Interior Stairwell
    - q. Sign Type N.2 - Informational or Caution/Prohibitory
    - r. Sign Type S - Free-Standing (Stance)

### **PART 3 EXECUTION**

#### **3.01 SITE VISITS**

- A. Site visits – 3 site visits shall be required by the sign contractor:
1. Prior to submission of bid for site assessment and evaluation.
  2. Post award for the purposes of meeting with Owners and project manager.
  3. Final walk-through and punchlist.
- B. Programming – sign contractor shall perform all wayfinding & programming. Programming shall include location plan, message schedule, and/or plots, fire/evacuation maps and insert graphics. All programming materials shall be submitted for approval.

### **3.02 CODE COMPLIANCE**

- A. It shall be the responsibility of the successful bidder to meet any and all local, state, and federal code requirements in fabricating and installing signs.

### **3.03 DELIVERY, STORAGE, PROTECTION**

- A. Package to prevent damage or deterioration during shipment, handling, storage and installation. Products should remain in original packaging until removal is necessary. Store products in a dry, indoor location.

### **3.04 EXAMINATION**

- A. Installer shall examine signs for defects, damage and compliance with specifications. Installation shall not proceed until unsatisfactory conditions are corrected.

### **3.05 INSTALLATION**

- A. General: Installation locations shall be in accordance with ADA specifications. Locate signs where indicated using mounting methods in compliance with manufacturer's written instructions:
  1. The signage contractor shall coordinate installation schedules with the Owner and/or Construction Manager.
  2. Installation shall be performed by manufacturer's personnel trained and certified in manufacturer's methods and procedures.
  3. The signage contractor shall submit a CAD generated location plan noting the location of all signage and cross referenced to message schedule or plots for architect's approval.
  4. Installer to conduct a pre-installation survey prior to manufacturing to verify copy and sign location. Each location shall be noted using a low tack vinyl reproduction of actual sign. Full scale renderings of directories and directionals shall also be provided. Any location discrepancy or message issues shall be submitted to architect for review.
  5. Signs shall be level, plumb, and at heights indicated with sign surfaces free from defects.
  6. Upon completion of the work, signage contractor shall remove unused or discarded materials, containers and debris from site.

### **3.06 WEB PORTAL AND STANDARDS MANUAL**

- A. Web Portal: Manufacturer shall provide a password protected web portal enabling Owner to view and access all sign types comprising the sign system. The sign types shall be priced and shall be capable of purchase directly from the portal.
- B. Manufacturer shall provide a comprehensive Standards Manual in both a paper and PDF format. The manual shall include all graphic standards, sign type descriptions, renderings showing color, pattern and finish, engineering drawings, location plans, plots, artwork, insert templates, mounting detail, and reorder information.

**END OF SECTION**

**SECTION 102113.17  
PHENOLIC TOILET COMPARTMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Phenolic toilet compartments.
- B. Urinal screens.

**1.02 RELATED REQUIREMENTS**

- A. Section 061000 - Rough Carpentry: Blocking and supports.
- B. Section 102800 - Toilet, Bath, and Laundry Accessories.

**1.03 REFERENCE STANDARDS**

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
- B. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth 2019.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

**1.05 SUBMITTALS**

- A. See Section 013000 Submittals for submittal procedures.
- B. Product Data: Provide data on panel construction, hardware, and accessories.
- C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Phenolic Toilet Compartments:
  - 1. All American Metal Corp - AAMCO: [www.allamericanmetal.com](http://www.allamericanmetal.com)
  - 2. ASI Accurate Partitions: [www.asi-accuratepartitions.com](http://www.asi-accuratepartitions.com)
  - 3. ASI Global Partitions: [www.asi-globalpartitions.com](http://www.asi-globalpartitions.com)
  - 4. Partition Systems International of South Carolina; Phenolic Toilet Partitions: [www.psisc.com](http://www.psisc.com)
  - 5. Substitutions: Section 016310 Product Substitutions

**2.02 PHENOLIC TOILET COMPARTMENTS**

- A. Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid phenolic core panels with integral melamine finish, floor-mounted headrail-braced.
- B. Doors:
  - 1. Thickness: 3/4 inch (19 mm).
  - 2. Width: 24 inch (610 mm).
  - 3. Width for Handicapped Use: 36 inch (915 mm).
  - 4. Height: 58 inch (1473 mm).
- C. Panels:
  - 1. Thickness: 1/2 inch (13 mm).
  - 2. Height: 58 inch (1473 mm).
- D. Pilasters:

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1. Thickness: 3/4 inch (19 mm).
  2. Width: As required to fit space; minimum 3 inch (76 mm).
- E. Screens: Without doors; to match compartments; mounted to wall with two panel brackets.
- F. Color: To be selected from manufacturer's full range by Architect.

**2.03 ACCESSORIES**

- A. Pilaster Shoes: Formed ASTM A666 Type 304 stainless steel with No. 4 finish, 3 inch (76 mm) high, concealing floor fastenings.
- B. Attachments, Screws, and Bolts: Stainless steel , tamper proof type.
- C. Hardware: Polished stainless steel:
1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
  2. Door Latch: Slide type with exterior emergency access feature.
  3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
  4. Coat hook with rubber bumper; one per compartment, mounted on door.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

**3.02 INSTALLATION**

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 inch to 1/2 inch (9 mm to 13 mm) space between wall and panels and between wall and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.

**3.03 TOLERANCES**

**END OF SECTION**

**SECTION 102123  
CUBICLE CURTAINS AND TRACK**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Surface mounted overhead curtain track and guides.

**1.02 RELATED REQUIREMENTS**

- A. Section 011000 - Summary: Tenant-installed curtains.
- B. Section 095100 - Acoustical Ceilings: Suspended ceiling system to support track.

**1.03 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for curtain fabric characteristics.
- C. Shop Drawings: Indicate a reflected ceiling plan view of curtain track, hangers and suspension points, attachment details, schedule of curtain sizes.

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Accept curtain materials on site and inspect for damage.
- B. Store curtain materials on site and deliver to Owner for installation when requested.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Cubicle Track and Curtains:
  - 1. On The Right Track: [www.ontherighttrack.com](http://www.ontherighttrack.com)
  - 2. Substitutions: Not permitted.

**2.02 TRACKS AND TRACK COMPONENTS**

- A. Tracks: Extruded aluminum sections; one piece per track run.
  - 1. Profile: Channel.
  - 2. Mounting: Surface.
  - 3. Track End Stop: To fit track section.
  - 4. Track Bends: Minimum 12 inch (300 mm) radius; fabricated without deformation of track section or impeding movement of carriers.
  - 5. Finish on Exposed Surfaces: White baked enamel.
- B. Curtain Carriers: Nylon rollers, size and type compatible with track; designed to eliminate bind when curtain is pulled; fitted to curtain to prevent accidental curtain removal.
- C. Curtains: Furnished and installed by Tenant (VA).
- D. Installation Accessories: Types required for specified mounting method and substrate conditions.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that surfaces and supports above ceiling are ready to receive work of this Section.

**3.02 INSTALLATION**

- A. Install curtain track to be secure, rigid, and true to ceiling line.
- B. Secure track to ceiling system.
- C. Install end cap and stop device.

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D. Install curtains on carriers ensuring smooth operation.

**END OF SECTION**

**SECTION 102600  
WALL AND DOOR PROTECTION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Bumper rails.
- B. Protective corridor handrails.
- C. Corner guards.
- D. Protective wall covering.

**1.02 RELATED REQUIREMENTS**

- A. Section 092116 - Gypsum Board Assemblies: Placement of supports in stud wall construction.

**1.03 REFERENCE STANDARDS**

- A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, and anchorage details.
- C. Samples: Submit samples illustrating component design, configurations, joinery, color and finish.
  - 1. Submit two sections of corner guards, bumper rails, and protective corridor handrails, 24 inches (610 mm) long.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.
- B. Protect work from moisture damage.
- C. Protect work from UV light damage.
- D. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Corner Guards and Corner Guards:
  - 1. Babcock-Davis: [www.babcockdavis.com](http://www.babcockdavis.com)
  - 2. Construction Specialties, Inc; Acrovyn Solid Color and Chameleon Corner Guards: [www.c-sgroup.com](http://www.c-sgroup.com)
  - 3. Inpro: [www.inprocorp.com](http://www.inprocorp.com)
  - 4. Substitutions: See Section 016310 - Product Substitutions.
- B. Bumper Rails and Protective Corridor Handrails:
  - 1. Babcock-Davis: [www.babcockdavis.com](http://www.babcockdavis.com)
  - 2. Construction Specialties, Inc; Acrovyn Solid Color and Chameleon Crash Rails: [www.c-sgroup.com](http://www.c-sgroup.com)
  - 3. Inpro: [www.inprocorp.com](http://www.inprocorp.com)



4. Substitutions: See Section 016310 - Product Substitutions.
- C. Protective Wall Covering:
  1. Construction Specialties, Inc; Acrovyn High-Impact Wall Covering: [www.c-sgroup.com](http://www.c-sgroup.com)
  2. Inpro: [www.inprocorp.com](http://www.inprocorp.com)
  3. Pawling Corp: [www.pawling.com](http://www.pawling.com)
  4. Substitutions: See Section 016310 - Product Substitutions.

## 2.02 PRODUCT TYPES

- A. Bumper Rails: Factory- or shop-fabricated, with preformed end caps and internal and external corners:
  1. Material: High impact vinyl, color as indicated.
  2. Mounting: Surface.
- B. Protective Corridor Handrails: Factory- or shop-fabricated, with preformed end caps and internal and external corners:
  1. Comply with accessibility requirements of ICC A117.1 and ADA Standards.
  2. Material: High impact vinyl, color as indicated.
  3. Mounting: Surface.
  4. Return rail to wall.
- C. Corner Guards - Surface Mounted:
  1. Material: Polyethylene terephthalate (PET or PETG); PVC-free with full height extruded aluminum retainer.
  2. Width of Wings: 2 inches (51 mm).
  3. Corner: Square.
  4. Color: As indicated.
  5. Length: One piece.
  6. Preformed end caps.
- D. Protective Wall Panels:
  1. Material: Fiber Reinforced Laminate (FRL): Thermofused melamine overlay, decorative paper and fire-rated phenolic paper with fiber reinforcing inner layers.
  2. Thickness: 0.075 inch (1.90 mm).
  3. Panel Size: 4 feet by 8 feet (1220 mm by 2440 mm).
  4. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 55 or less, when tested in accordance with ASTM E84.
  5. Color and Pattern: As scheduled.
  6. Texture: As selected from manufacturer's standard textures.
  7. Accessories: Provide manufacturer's standard PVC color-matched trim and moldings.
  8. Mounting: Adhesive.

## 2.03 FABRICATION

- A. Fabricate components with tight joints, corners and seams.

## 2.04 SOURCE QUALITY CONTROL

- A. Provide wall and door protection systems of each type from a single source and manufacturer.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.

### 3.02 INSTALLATION

- A. Position top of bumper rail 36 inches (914 mm) from finished floor.

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- B. Position top of corridor hand rail 36 inches (914 mm) from finished floor.
- C. Position corner guard 4 inches (102 mm) above finished floor to 48 inches high (1219 mm high).
- D. Terminate rails 1 inch (25.4 mm) short of door openings and intersecting walls.

**3.03 TOLERANCES**

- A. Maximum Variation From Required Height: 1/4 inch (6 mm).

**3.04 CLEANING**

- A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

**3.05 SCHEDULE**

- A. CG-1
  - 1. Corner Guard
    - a. Product: Inpro
    - b. Style: 130BN BluNose High Impact
    - c. Color: 0380 Gala
    - d. Location: See Wall Finish Plan for locations.
- B. HR-1
  - 1. Handrail
    - a. Product: Inpro
    - b. Style: 3500 Series, Vinyl Top/Stainless Steel Bottom
    - c. Color: 0280 Shiprock
    - d. Location: See Floor Plan for locations.
- C. RWC-1
  - 1. Wall Protection
    - a. Product: Inpro
    - b. Style: Palladium Rigid Sheet
    - c. Color: 0380 Galla
    - d. Location: Wheelchair Alcove (101), HAC (174) & Soiled Utility (193). See interior elevations.

**END OF SECTION**

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**SECTION 102800  
TOILET, BATH, AND LAUNDRY ACCESSORIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Commercial toilet accessories.
- B. Commercial shower and bath accessories.
- C. Under-lavatory pipe supply covers.
- D. Diaper changing stations.
- E. Utility room accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 093000 - Tiling: Ceramic washroom accessories.

**1.03 REFERENCE STANDARDS**

- A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
- E. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium 2017.
- F. ASTM C1036 - Standard Specification for Flat Glass 2021.
- G. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror 2018.
- H. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use 2004, with Editorial Revision (2016).
- I. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

**1.04 SUBMITTALS**

- A. See Section 013000 Submittals for submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Commercial Toilet, Shower, and Bath Accessories:
  - 1. Bobrick. (unless otherwise indicated, Bobrick numbers are specified)
  - 2. American Specialties, Inc: [www.americanspecialties.com](http://www.americanspecialties.com)
  - 3. Bradley Corporation: [www.bradleycorp.com](http://www.bradleycorp.com)
  - 4. Substitutions: Section 016310 Product Substitutions
- B. Provide products of each category type by single manufacturer.

**2.02 MATERIALS**

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
- B. Keys: Provide three keys for each accessory to Tenant; master key lockable accessories.

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- C. Stainless Steel Sheet: ASTM A666, Type 304.
- D. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
- E. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
- F. Adhesive: Two component epoxy type, waterproof.
- G. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
- H. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

### **2.03 FINISHES**

- A. Stainless Steel: Satin finish, unless otherwise noted.
- B. Chrome/Nickel Plating: ASTM B456, SC 2, polished finish, unless otherwise noted.

### **2.04 COMMERCIAL TOILET ACCESSORIES**

- A. Toilet Paper Dispenser: B-3588
- B. Tempered Mirrors: B-2908, sizes as indicated on the drawings.
- C. Recessed Seat Cover Dispenser: B-301
- D. Grab Bars: B6808 series, lengths as indicated on the drawings.
- E. Bariatric Grab Bars: Bradley 812 series; lengths as indicated on the drawings.
- F. Stainless Steel Shelf: Gamco MS-24
- G. Sanitary Napkin Dispenser: B-47064C
- H. Sanitary Napkin Disposal Unit: B-270
- I. Pass Thru Specimen Cabinet: B-505
- J. Fold Down ADA Bench: Versable Designs - D-101-42 - White (PW)

### **2.05 DIAPER CHANGING STATIONS**

- A. Diaper Changing Station: Bobrick KB110-SSWM

### **2.06 UTILITY ROOM ACCESSORIES**

- A. Combination Utility Shelf/Mop and Broom Holder: B-239

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. Verify that field measurements are as instructed by the manufacturer.

### **3.02 PREPARATION**

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

### **3.03 INSTALLATION**

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

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**3.04 PROTECTION**

- A. Protect installed accessories from damage due to subsequent construction operations.

**END OF SECTION**

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**SECTION 104400  
FIRE PROTECTION SPECIALTIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

**1.02 REFERENCE STANDARDS**

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2013a (Reapproved 2017).
- B. NFPA 10 - Standard for Portable Fire Extinguishers 2022.

**1.03 SUBMITTALS**

- A. See Section 013000 Substitutions for submittal procedures.
- B. Product Data: Provide extinguisher operational features.
- C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.

**1.04 FIELD CONDITIONS**

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Fire Extinguishers:
  - 1. Activar Construction Products Group, Inc. - JL Industries; Cosmic Extinguisher - Multipurpose Chemical: [www.activarcpg.com](http://www.activarcpg.com)
  - 2. Kidde, a unit of United Technologies Corp: [www.kidde.com](http://www.kidde.com)
  - 3. Nystrom, Inc: [www.nystrom.com](http://www.nystrom.com)
  - 4. Substitutions: See Section 016310 - Product Substitutions.
- B. Fire Extinguisher Cabinets and Accessories:
  - 1. Activar Construction Products Group, Inc. - JL Industries; Ambassador Series: [www.activarcpg.com](http://www.activarcpg.com)
  - 2. Larsen's Manufacturing Co: [www.larsensmfg.com](http://www.larsensmfg.com)
  - 3. Nystrom, Inc: [www.nystrom.com](http://www.nystrom.com)
  - 4. Substitutions: See Section 016310 - Product Substitutions.

**2.02 FIRE EXTINGUISHERS**

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
- B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
  - 1. Class: A:B:C type.
  - 2. Size: 10 pound (4.54 kg).
  - 3. Temperature range: Minus 40 degrees F (Minus 40 degrees C) to [ ] degrees F ([ ] degrees C).

**2.03 FIRE EXTINGUISHER CABINETS**

- A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.
- B. Fire Rated Cabinet Construction: One-hour fire rated.
- C. Cabinet Configuration: Recessed type.



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1. Size to accommodate accessories.
  2. Trim: Flat rolled edge.
- D. Door: 0.036 inch (0.9 mm) metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinges.
  - E. Door Glazing: Float glass, clear, 1/8 inch (3 mm) thick, and set in resilient channel glazing gasket.
  - F. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
  - G. Finish of Cabinet Exterior Trim and Door: No.4 - Brushed stainless steel.
  - H. Finish of Cabinet Interior: White colored enamel.

**2.04 ACCESSORIES**

- A. Lettering: FIRE EXTINGUISHER decal, or vinyl self-adhering, pre-spaced black lettering in accordance with authorities having jurisdiction (AHJ).

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify rough openings for cabinet are correctly sized and located.

**3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.

**3.03 MAINTENANCE**

- A. Provide a separate maintenance contract for specified maintenance service.

**END OF SECTION**

**SECTION 105113  
METAL LOCKERS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Metal lockers.

**1.02 RELATED REQUIREMENTS**

- A. Section 061000 - Rough Carpentry: Wood blocking and nailers.

**1.03 REFERENCE STANDARDS**

- A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.
- B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications 2022a.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- D. ASTM A879/A879M - Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface 2022.
- E. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2021a.
- F. ASTM F1267 - Standard Specification for Metal, Expanded, Steel 2018.
- G. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

**1.04 SUBMITTALS**

- A. See Section 013000 Substitutions for submittal procedures.
- B. Product Data: Manufacturer's published data on locker construction, sizes, and accessories.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Protect locker finish and adjacent surfaces from damage.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Metal Lockers:
  - 1. ASI Storage Solutions: [www.asi-storage.com](http://www.asi-storage.com)
  - 2. Lyon Workspace Products: [www.lyonworkspace.com](http://www.lyonworkspace.com)
  - 3. Penco Products, Inc: [www.pencoproducts.com](http://www.pencoproducts.com)
  - 4. Republic Storage Systems Co: [www.republicstorage.com](http://www.republicstorage.com)
  - 5. Substitutions: See Section 016310 - Product Substitutions.

**2.02 LOCKER APPLICATIONS**

- A. Wardrobe Lockers: Metal lockers, wall mounted with matching closed base.
  - 1. Width: 12 inches (305 mm).
  - 2. Depth: 18 inches (457 mm).
  - 3. Height: 72 inches (1830 mm).
  - 4. Configuration: Three tier.
  - 5. Fittings: Size and configuration as indicated on drawings.
  - 6. Ventilation: Louvers at top and bottom of door panel.
  - 7. Locking: Padlock hasps, for padlocks provided by Owner.
  - 8. Provide sloped top.
  - 9. Color: To be selected from manufacturer's full range by Architect.

### **2.03 METAL LOCKERS**

- A. Accessibility: Design units indicated on drawings as 'accessible' to comply with ICC A117.1 and ADA Standards.
- B. Locker Case Construction:
  - 1. Heavy-Duty, Welded Construction: Made of formed and welded together sheet steel; metal edges finished smooth without burrs; baked enamel or powder coat finished inside and out.
- C. Latches and Door Handles: Manufacturer's standard.
- D. Hinges: Full height of locker, manufacturer's standard heavy duty type.
- E. Sloped Top: 20 gauge, 0.0359 inch (0.91 mm), with closed ends.
- F. Coat Hooks: Stainless steel or zinc-plated steel.
- G. Number Plates: Provide rectangular shaped aluminum plates.
- H. Locks: Locker manufacturer's standard type indicated in Applications article above.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that prepared bases are in correct position and configuration.

#### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Place and secure on prepared base.
- C. Install lockers plumb and square.
- D. Install end panels, filler panels, and sloped tops.
- E. Install fittings if not factory installed.
- F. Replace components that do not operate smoothly.

#### **3.03 CLEANING**

- A. Clean locker interiors and exterior surfaces.

**END OF SECTION**

**SECTION 108600  
SAFETY AND SECURITY MIRRORS AND DOMES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Dome Mirrors.

**1.02 RELATED SECTIONS**

- A. Section 09116 - Gypsum Board Assemblies.
- B. Section 095100 - Acoustical Ceilings.

**1.03 SUBMITTALS**

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation Instructions.
- B. Shop Drawings:
  - 1. Locate each specified unit in project.
  - 2. Indicate mounting height of each unit.
  - 3. Include anchoring and fastening details.
- C. Selection Samples: Manufacturer's standard color fans for selection of colors and finishes.
- D. Verification Samples: Submit samples of each product specified, illustrating color and finish. Approved samples will be returned to the Contractor and may be used in the project.
- E. Closeout Submittals: Provide manufacturer's maintenance instructions that include recommendations for periodic checking and adjustment of all components.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Minimum ten years documented experience producing products specified.
- B. Installer Qualifications: Minimum five years documented experience installing products specified.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products after building is enclosed, other work within spaces where products are to be installed is substantially complete, and installation is ready to take place.
- B. Protect products from damage before, during and after installation.
- C. Store products in manufacturer's unopened packaging until ready for installation.

**1.06 COORDINATION AND SEQUENCING**

- A. Coordinate installation of blocking, bracing and backing to receive products of this section.
- B. Supply installation templates, required reinforcing, and recessed anchorage devices in timely fashion to installers of related work that will receive products of this section.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Acceptable Manufacturer: Fred Silver & Company, Inc. 8180 Granville Road, Mount Vernon OH 43050. ASD. Phone Toll Free: 800-322-5929. Fax: 740-397-1198. Web: [www.fredsilver.com](http://www.fredsilver.com). Email: [info@fredsilver.com](mailto:info@fredsilver.com).
- B. Substitutions: See Section 016310 Product Substitutions

## **2.02 DOME MIRRORS**

- A. Half Dome Mirrors
  - 1. Features:
    - a. 180 degree viewing area
    - b. Wall mounted or ceiling mounted
    - c. Available in Acrylic or Polycarbonate
  - 2. Models:
    - a. H-DOME-18
      - 1) Size: 18 inch diameter
      - 2) Lens Material: Acrylic Shatter Resistant
      - 3) Square Feet of Coverage: 150
      - 4) Location: See Reflected Ceiling Plan
- B. Quarter Dome Mirrors
  - 1. Features:
    - a. 90 degree viewing area
    - b. Corner wall mounted or corner ceiling mounted
    - c. Available in Acrylic or Polycarbonate
  - 2. Models:
    - a. Q-DOME-26
      - 1) Size: 26 inch diameter
      - 2) Lens Material: Acrylic Shatter Resistant
      - 3) Square Feet of Coverage: 75
      - 4) Location: See Reflected Ceiling Plan

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Do not begin installation until substrates have been properly prepared.
- B. Verify that mounting surfaces and prepared openings are sized and located in accordance with approved shop drawings. Verify that blocking, reinforcement and anchoring devices are the correct type, have been located correctly, and have been installed properly.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### **3.02 PREPARATION**

- A. Provide templates and rough-in measurements as required.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install plumb, level and rigidly anchored to substrate.
- C. Locate accessories as indicated on the drawings. Adjust to provide the optimal visual field.

### **3.04 CLEANING**

- A. Remove labels after Work is complete.
- B. Clean surfaces as required, following procedures and employing cleaning materials as recommended by accessories manufacturer.

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**3.05 PROTECTION**

- A. Protect installed products from damage by subsequent construction activities, until completion of project.
- B. Field repair of damaged product finishes is prohibited. Replace products that have been damaged by subsequent construction activities.

**END OF SECTION**

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**SECTION 117311  
PATIENT LIFTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Patient lift equipment with powered operating system and overhead-supported tracks.

**1.02 RELATED REQUIREMENTS**

- A. Section 095100 - Acoustical Ceilings.

**1.03 REFERENCE STANDARDS**

- A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.
- B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2021.

**1.04 SUBMITTALS**

- A. See Section 013000 Submittals for submittal procedures.
- B. Product Data: Provide manufacturer's data sheets of operating system components, track system components, track depth, track maneuverability systems, slings, and accessories. Indicate dimensions, performance requirements, service requirements, materials, finishes, and options
- C. Shop Drawings: Indicate dimensions, reflected ceiling plan track layouts, above-ceiling support requirements, attachment-to-support details, point loads, and power-supply connections.
- D. Manufacturer's Qualification Statement.
- E. Installer's Qualification Statement.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with minimum three years of documented experience and approved by manufacturer.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Package equipment to project site in protective packaging.
- B. Protect finished surfaces during handling and installation with protective covering of polyethylene film or another suitable material.

**1.07 WARRANTY**

- A. Correct defective Work within a two year period after Date of Substantial Completion.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Patient Lifts:
  - 1. Hillrom: [www.hill-rom.com](http://www.hill-rom.com).
  - 2. Substitutions: Not permitted.

**2.02 OPERATING SYSTEM**

- A. Battery-operated patient lift mounted in track system to transfer patients along track system; capable of both powered and manual traverse movement.
  - 1. Lifts per Charge: 120 lifts, nominal.
  - 2. Battery Charging Options: Docking station charging.



### **2.03 TRACK SYSTEM**

- A. Description: Manufacturer's standard track systems capable of varying track configuration layouts.
  - 1. Track Depth:
    - a. Standard Track: 2.31 inches wide by 2.66 inches high (58.70 mm wide by 67.74 mm high) ; 650 lbs (295 kgs) capacity.
  - 2. Track Maneuverability Systems:
    - a. Refer to drawings for layout.
- B. Materials:
  - 1. Track: Extruded aluminum, ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
- C. Finish: Powder coated aluminum.
- D. Color: Bright white.

### **2.04 ACCESSORIES**

- A. Slings: Manufacturer's standard sling with load rating equal to or greater than load rating of lift.
- B. Installation Accessories: Provide necessary accessories and closure trim as required for complete installation.
- C. Fasteners: Manufacturer's standard inserts, anchors, bolts, rivets, and screws appropriate for project conditions; corrosion-resistant.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verification of Conditions: Examine areas and conditions, with installer present, for compliance with requirements of supporting structural members, installation tolerances, and other conditions that may impact performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 INSTALLATION**

- A. Install equipment in accordance with manufacturer's instructions and approved shop drawings.
- B. Set components plumb, level, and rigid.
- C. Install anchors in accordance with anchor manufacturer's installation guidelines.
- D. Track System Interface with Finish Ceiling: Install track system relative to finish ceiling for top of track at bottom of ceiling installation.
  - 1. Coordinate track system interface with components of Section 095100 - Acoustical Ceilings.

### **3.03 ADJUSTING**

- A. Adjust operating equipment for smooth and efficient operation throughout full operating cycle.

### **3.04 CLOSEOUT ACTIVITIES**

- A. See Section 017900 - Demonstration and Training, for additional requirements.
- B. Demonstrate proper operation of equipment to Owner's designated representative.
- C. Training: Train Owner's personnel on operation and maintenance of system.
  - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
  - 2. Provide minimum of two hours of training.
- D. Final Acceptance: Remove labels, fingerprints; clean surfaces. Repair any marred or damaged surfaces that effect appearance in manner not acceptable to Owner. Replace any parts that cannot be repaired in such a manner.

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**3.05 PROTECTION**

- A. Protect installed equipment from subsequent construction operations.

**3.06 SCHEDULE**

- A. Patient Lift Equipment:
  - 1. Type Likorall 250 ES, as specified herein and manufactured by Hillrom.
  - 2. Location: Procedure Restroom 111 & Procedure Room 112.

**END OF SECTION**

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**SECTION 122400  
WINDOW SHADES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Interior manual roller shades.

**1.02 RELATED REQUIREMENTS**

- A. Section 061000 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

**1.03 REFERENCE STANDARDS**

- A. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015, with Editorial Revision (2021).
- B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films 2019.
- C. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems Current Edition, Including All Revisions.
- D. WCMA A100.1 - Safety of Window Covering Products 2018.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Sequencing:
  - 1. Do not fabricate shades until field dimensions for each opening have been taken with field conditions in place.

**1.05 SUBMITTALS**

- A. See Section 013000 Substitutions for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
- C. Source Quality Control Submittals: Provide test reports indicating compliance with specified fabric properties.
- D. Selection Samples: Include fabric samples in full range of available colors and patterns.
- E. Verification Samples: Minimum size 6 inches (150 mm) square, representing actual materials, color and pattern.

**1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of this type with minimum five years of documented experience with shading systems of similar size and type.

**1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.
- B. Handle and store shades in accordance with manufacturer's recommendations.

**1.08 FIELD CONDITIONS**

**1.09 WARRANTY**

- A. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
  - 1. Shade Hardware: 10 years.
  - 2. Fabric: 10 years.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Interior Manually Operated Roller Shades:
  - 1. MechoShade Systems LLC; Mecho/5x: [www.mechoshade.com](http://www.mechoshade.com)
  - 2. Substitutions: See Section 016310 Product Substitutions

### **2.02 ROLLER SHADES**

- A. General:
  - 1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
  - 2. Provide shade system that operates smoothly when shades are raised or lowered.
- B. Roller Shades Type RS-1:
  - 1. Basis of Design: Mecho/5x.
  - 2. Description - Interior Roller Shades: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
    - a. Drop Position: Regular roll.
    - b. Roll Direction: Roll down, closed position is at window sill.
    - c. Mounting: Window jamb mounted - inside, between jambs.
    - d. Size: As indicated on drawings.
    - e. Fabric: As indicated under Shade Fabric article.
  - 3. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
  - 4. Roller Tubes: As required for type of shade operation.
    - a. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
  - 5. Hembars: Designed to maintain bottom of shade straight and flat.
  - 6. Manual Operation for Interior Shades:
    - a. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.
    - b. Drive Chain: Continuous loop beaded ball chain, 95 pounds (43 kg) minimum breaking strength. Provide upper and lower limit stops.
    - c. Shade Lift Assistance: Manufacturer's standard spring device contained in the idler end of roller tube to reduce force required to lift shades; as required based on shade weight.
    - d. Chain Retainer:
      - 1) Chain tensioning device complying with WCMA A100.1.
  - 7. Accessories:
    - a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; clear anodized finish.

### **2.03 SHADE FABRIC**

- A. Fabric: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
  - 1. Manufacturers:
    - a. MechoShade Systems LLC; EuroTwill 6200 Series: [www.mechoshade.com](http://www.mechoshade.com)
    - b. Substitutions: Not permitted.
  - 2. Openness Factor: 1%.
  - 3. Color: 6206 Silver Birch.

## **2.04 ROLLER SHADE FABRICATION**

- A. Field measure finished openings prior to ordering or fabrication.
- B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
  - 1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch (13 mm) space between bottom bar and window sill.
  - 2. Horizontal Dimensions - Inside Mounting: Fill openings from jamb to jamb.
- C. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine finished openings for deficiencies that may preclude satisfactory installation.
- B. Start of installation shall be considered acceptance of substrates.

### **3.02 PREPARATION**

- A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.
- B. Coordinate with window installation and placement of concealed blocking to support shades.

### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
- B. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.
- C. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

### **3.04 CLEANING**

- A. Clean soiled shades and exposed components as recommended by manufacturer.
- B. Replace shades that cannot be cleaned to "like new" condition.

### **3.05 CLOSEOUT ACTIVITIES**

- A. See Section 017900 - Demonstration and Training, for additional requirements.
- B. Demonstration: Demonstrate operation and maintenance of window shade system to Owner's personnel.

### **3.06 PROTECTION**

- A. Protect installed products from subsequent construction operations.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.

**END OF SECTION**

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**SECTION 123200  
MANUFACTURED WOOD CASEWORK**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Manufactured standard and custom casework, with cabinet hardware.

**1.02 RELATED REQUIREMENTS**

- A. Section 061000 - Rough Carpentry: Blocking and nailers for anchoring casework.
- B. Section 079200 - Joint Sealants: Sealing joints between casework and countertops and adjacent walls, floors, and ceilings.
- C. Section 092116 - Gypsum Board Assemblies: Reinforcements in metal-framed partitions for anchoring casework.
- D. Section 123600 - Countertops: Additional requirements for countertops.

**1.03 DEFINITIONS**

- A. Exposed: Portions of casework visible when drawers and cabinet doors are closed, including end panels, bottoms of cases more than 42 inches (1.066 m) above finished floor, tops of cases less than 72 inches (1.82 m) above finished floor and all members visible in open cases or behind glass doors.
- B. Semi-Exposed: Portions of casework and surfaces behind solid doors, tops of cases more than 72 inches (1.828 m) above finished floor and bottoms of cabinets more than 30 inches (0.762 m) but less than 42 inches (1.066 m) above finished floor.
- C. Concealed: Sleepers, web frames, dust panels and other surfaces not generally visible after installation and cabinets less than 30 inches (762 mm) above finished floor.

**1.04 REFERENCE STANDARDS**

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition 2014, with Errata (2016).
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards 2021, with Errata.
- C. BHMA A156.9 - Cabinet Hardware 2020.
- D. NEMA LD 3 - High-Pressure Decorative Laminates 2005.

**1.05 SUBMITTALS**

- A. See Section 013000 Substitutions for submittal procedures.
- B. Product Data: Component dimensions, configurations, construction details, joint details, attachments.
- C. Shop Drawings: Indicate casework types, sizes, and locations, using large scale plans, elevations, and cross sections. Include rough-in and anchors and reinforcements, placement dimensions and tolerances, clearances required, and keying information.
- D. Samples for Finish Selection: Fully finished, for color selection. Minimum sample size: 2 inches by 3 inches (51 mm by 75 mm).
  - 1. Plastic laminate samples, for color, texture, and finish selection.
  - 2. Solid phenolic samples, for color, texture, and finish selection.
- E. Maintenance Data: Manufacturer's recommendations for care and cleaning.
- F. Finish touch-up kit for each type and color of materials provided.



### 1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience and approved by manufacturer.

### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect items provided by this section, including finished surfaces and hardware items during handling and installation. For metal surfaces, use polyethylene film or other protective material standard with the manufacturer.
- B. Acceptance at Site:
  - 1. Do not deliver or install casework until the conditions specified under Part 3, Examination Article of this section have been met. Products delivered to sites that are not enclosed and/or improperly conditioned will not be accepted if warping or damage due to unsatisfactory conditions occurs.
- C. Storage:
  - 1. Store casework in the area of installation. If necessary, prior to installation, temporarily store in another area, meeting the environmental requirements specified under Part 3, "Site Verification of Conditions" Article of this section.

### 1.08 WARRANTY

- A. Correct defective Work within a five year period after Date of Substantial Completion, at no additional cost to Owner. Defects include, but are not limited to:
  - 1. Ruptured, cracked, or stained finish coating.
  - 2. Discoloration or lack of finish integrity.
  - 3. Cracking or peeling of finish.
  - 4. Failure of hardware.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Plastic Laminate Casework:
  - 1. Arbortie; [www.arborite](http://www.arborite)
  - 2. Case Systems: [www.casesystems.com](http://www.casesystems.com)
  - 3. Diversified Fixture: [www.diversifiedfixture.com](http://www.diversifiedfixture.com)
  - 4. Labscape LLC: [www.labscape.com](http://www.labscape.com)
  - 5. Substitutions: See Section 016310 - Product Substitutions.

### 2.02 CASEWORK, GENERAL

- A. Quality Standard: AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Plastic Laminate Faced Cabinets: [\_\_\_\_\_].

### 2.03 FABRICATION

- A. Assembly: Shop assemble casework items for delivery to site in units easily handled and to permit passage through building openings.
- B. Construction: As required for selected grade.
- C. Structural Performance: Safely support the following minimum loads:
  - 1. Base Units: 500 pounds per linear foot (744 kgs/linear m) across the cabinet ends.
  - 2. Suspended Units: 300 pounds (136 kg) static load.
  - 3. Drawers: 125 pounds (57 kg), minimum.
  - 4. Hanging Wall Cases: 300 pounds (135 kg).

5. Shelves: 100 pounds (45 kg), minimum.
- D. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

#### **2.04 PLASTIC-LAMINATE-CLAD CASEWORK**

- A. Plastic-Laminate-Clad Casework: Solid wood and wood panel construction; each unit self-contained and not dependent on adjacent units or building structure for rigidity; in sizes necessary to avoid field cutting except for scribes and filler panels. Include adjustable levelers for base cabinets.
  1. Style: Flush overlay. Ease doors and drawer fronts slightly at edges.
  2. Cabinet Nominal Dimensions: Unless otherwise indicated, provide cabinets of widths and heights indicated on drawings, and with following front-to-back dimensions:
    - a. Base Cabinets: 23 inch (585 mm).
    - b. Wall Cabinets: 13 inches (330 mm).
  3. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline.
    - a. Finish: Matte or suede, gloss rating of 5 to 20.
    - b. Surface Color and Pattern: As scheduled.
    - c. Exposed Interior Surfaces: Thermally fused laminate.
      - 1) Color: White.

#### **2.05 COUNTERTOPS**

- A. Countertops: See Section 123600.

#### **2.06 CABINET HARDWARE**

- A. Manufacturer's standard types, styles and finishes.
- B. Comply with BHMA A156.9 requirements.
- C. Locks: Provide locks on casework drawers and doors where indicated. Lock with 5 pin cylinder and 2 keys per lock.
  1. Hinged Doors: Cam type lock, bright chromium plated over nickel on base material.
  2. Keying: Key locks as follows:
    - a. Keyed Seperate:
      - 1) Drug Dispensing (119)
      - 2) Patient Restroom & Shower (166)
    - b. Keyed Alike:
      - 1) Procedure Room (112), Triage Room (113), Lab (128) & Women's Health Exam (141)
- D. Shelves in Cabinets:
  1. Shelf Standards and Rests: Vertical standards with rubber button fitted rests, satin chromium plated over nickel on base material.
- E. Swinging Doors: Hinges, pulls, and catches.
  1. Hinges: Visible, number as required by referenced standards for width, height, and weight of door.
    - a. Visible Hinges: Installed on framed cabinet face, and on door face, bright chromium plated over nickel on base material.
    - b. Concealed Hinges: Installed in cabinet edge, and on door back, bright chromium plated over nickel on base material.
      - 1) European-Style Hinges for Overlay Doors: 125 degree opening angle.
  2. Pulls: Chrome wire pulls, 4 inches (102 mm) wide.
    - a. Pull design to comply with project's referenced accessibility requirements.
  3. Catches: Magnetic.

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- F. Drawers: Pulls and slides.
  - 1. Pulls: Chrome wire pulls, 4 inches (102 mm) wide.
  - 2. Slides: Steel, full extension arms, ball bearings; self-closing; capacity as recommended by manufacturer for drawer height and width.

## 2.07 MATERIALS

- A. Wood-Based Materials:
  - 1. Solid Wood: Air-dried to 4.5 percent moisture content, then tempered to 6 percent moisture content before use.
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications, complying with Grade requirements, and standard with the manufacturer.
- C. Thermally Fused Laminate (TFL): Melamine resin, NEMA LD 3, Type VGL laminate panels.

## 2.08 ACCESSORIES

- A. Plastic Edge Banding: Extruded PVC, convex shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
  - 1. Color: As selected by Architect from manufacturer's standard range.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Site Verification of Environmental Conditions:
  - 1. Do not deliver casework until the following conditions have been met:
    - a. Building has been enclosed (windows and doors sealed and weather-tight).
    - b. An operational HVAC system that maintains temperature and humidity at occupancy levels has been put in place.
    - c. Ceiling, overhead ductwork, piping, and lighting have been installed.
    - d. Installation areas do not require further "wet work" construction.
- B. Verify adequacy of support framing and anchors.
- C. Verify that service connections are correctly located and of proper characteristics.

### 3.02 INSTALLATION

- A. Perform installation in accordance with manufacturer's instructions.
- B. Use anchoring devices to suit conditions and substrate materials encountered. Use concealed fasteners to the greatest degree possible. Use exposed fasteners only where allowed by approved shop drawings, or where concealed fasteners are impracticable.
- C. Set casework items plumb and square, securely anchored to building structure.
- D. Align cabinets to adjoining components, install filler and/or scribe panels where necessary to close gaps.
- E. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed 1/16 inch ( 1.6 mm). In addition, do not exceed the following tolerances:
  - 1. Variation of Tops of Base Cabinets from Level: 1/16 inch ( 1.6 mm) in 10 feet (3 m).
  - 2. Variation of Faces of Cabinets from a True Plane: 1/8 inch (3 mm) in 10 feet (3 m).
  - 3. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch (0.8 mm).
  - 4. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch ( 1.6 mm).
- F. Base Cabinets: Fasten cabinets to service space framing and/or wall substrates, with fasteners spaced not more than 16 inches (407 mm) on center. Bolt adjacent cabinets together with joints flush, tight, and uniform.
- G. Install hardware uniformly and precisely.

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- H. Countertops: Install countertops intended and furnished for field installation in one true plane, with ends abutting at hairline joints, and no raised edges.
- I. Replace units that are damaged, including those that have damaged finishes.

**3.03 ADJUSTING**

- A. Adjust operating parts, including doors, drawers, hardware, and fixtures to function smoothly.

**3.04 CLEANING**

- A. Clean casework and other installed surfaces thoroughly.

**3.05 PROTECTION**

- A. Do not permit finished casework to be exposed to continued construction activity.
- B. Protect casework and countertops from ongoing construction activities. Prevent workmen from standing on, or storing tools and materials on casework or countertops.
- C. Repair damage, including to finishes, that occurs prior to Date of Substantial Completion, using methods prescribed by manufacturer; replace units that cannot be repaired to like-new condition.

**3.06 SCHEDULES**

- A. PL-1
  - 1. Plastic Laminate
  - 2. Product: Wilsonart
  - 3. Color: Drift Cedar Y0815
  - 4. Location: Base and Upper cabinets
- B. PL-2
  - 1. Plastic Laminate
  - 2. Product: Wilsonart
  - 3. Color: Phantom Cocoa 8213
  - 4. Location: Check-In / Check-Out (103) wing walls and at Lab Check-In wing walls.

**END OF SECTION**

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**SECTION 123600  
COUNTERTOPS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Countertops for manufactured casework.

**1.02 RELATED REQUIREMENTS**

- A. Section 123200 - Manufactured Wood Casework.

**1.03 REFERENCE STANDARDS**

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.
- B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition 2014, with Errata (2016).
- C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards 2021, with Errata.
- D. ISFA 2-01 - Classification and Standards for Solid Surfacing Material 2013.
- E. ISFA 3-01 - Classification and Standards for Quartz Surfacing Material 2013.
- F. NEMA LD 3 - High-Pressure Decorative Laminates 2005.
- G. NSI (DSDM) - Dimensional Stone Design Manual, Version VIII 2016.
- H. SEFA 2 - Installations 2010.

**1.04 SUBMITTALS**

- A. See Section 013000 Substitutions for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Specimen warranty.
- C. Shop Drawings: Complete details of materials and installation ; combine with shop drawings of cabinets and casework specified in other sections.
- D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.
- E. Test Reports: Chemical resistance testing, showing compliance with specified requirements.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

**1.06 FIELD CONDITIONS**

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

**PART 2 PRODUCTS**

**2.01 COUNTERTOPS**

- A. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
  - 1. Flat Sheet Thickness: 1/2 inch (12 mm), minimum.

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2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
    - a. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
    - b. Color and Pattern: As scheduled.
  3. Other Components Thickness: 1/2 inch (12 mm), minimum.
  4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch (32 mm) thick; square edge; use marine edge at sinks.
  5. Back and End Splashes: Same sheet material, square top; minimum 4 inches (102 mm) high.
  6. Skirts: As indicated on drawings.
  7. Fabricate in accordance with manufacturer's standard requirements.
- B. Natural Quartz and Resin Composite Countertops: Sheet or slab of natural quartz and plastic resin over continuous substrate.
1. Flat Sheet Thickness: 1-1/4 inch (32 mm), minimum.
  2. Natural Quartz and Resin Composite Sheets, Slabs and Castings: Complying with ISFA 3-01 and NEMA LD 3; orthophthalic polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard stone fabrication tools; no surface coating; color and pattern consistent throughout thickness.
    - a. Factory fabricate components to the greatest extent practical in sizes and shapes indicated; comply with NSI (DSDM).
    - b. Finish on Exposed Surfaces: Polished.
    - c. Color and Pattern: As scheduled.
  3. Other Components Thickness: 3/4 inch (19 mm), minimum.

## 2.02 FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
  1. Join lengths of tops using best method recommended by manufacturer.
  2. Fabricate to overhang fronts and ends of cabinets 1 inch (25 mm) except where top butts against cabinet or wall.
  3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
  1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
  2. Height: 4 inches (102 mm), unless otherwise indicated.
- C. Solid Surfacing: Fabricate tops and wall panels up to 144 inches (3,657 mm) long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

### **3.02 INSTALLATION**

- A. Install laboratory worksurface countertops in compliance with requirements of SEFA 2.
- B. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- C. Seal joint between back/end splashes and vertical surfaces.

### **3.03 TOLERANCES**

- A. Variation From Horizontal: 1/8 inch in 10 feet (3 mm in 3 m), maximum.
- B. Offset From Wall, Countertops: 1/8 inch (3 mm) maximum; 1/16 inch (1.5 mm) minimum.
- C. Field Joints: 1/8 inch (3 mm) wide, maximum.

### **3.04 CLEANING**

- A. Clean countertops surfaces thoroughly.

### **3.05 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

### **3.06 SCHEDULES**

- A. SS-1
  - 1. Solid Surface
  - 2. Product: Corian
  - 3. Color: Lava Rock
  - 4. Location: Countertops
- B. QTZ-1
  - 1. Quartz
  - 2. Product: Wilsonart Q4057
  - 3. Color: Calacatta Volegno
  - 4. Location: Check-In / Check-Out (103)

**END OF SECTION**



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**SECTION 220000**  
**PLUMBING BASIC REQUIREMENTS**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Work included in 22 00 00, Plumbing Basic Requirements applies to Division 22, Plumbing work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of plumbing systems for proposed project.
- B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.
- C. Definitions:
  - 1. Provide: To furnish and install, complete and ready for intended use.
  - 2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
  - 3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work furnished.
  - 4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent", substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.
  - 5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's Authorized Representative, and other reviewing entity whose approval is required to obtain systems acceptance.

**1.02 RELATED SECTIONS**

- A. Contents of Section applies to Division 22, Plumbing Contract Documents.
- B. Related Work:
  - 1. Additional conditions apply to this Division including, but not limited to:
    - a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
    - b. Drawings
    - c. Addenda
    - d. Owner/Architect Agreement
    - e. Owner/Contractor Agreement
    - f. Codes, Standards, Public Ordinances and Permits

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards per Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, individual Division 22, Plumbing Sections and those listed in this Section.
- B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:
  - 1. State of Oregon:
    - a. OAR - Oregon Administrative Rules
    - b. 2021 OESC - Oregon Electrical Specialty Code
    - c. 2019 OFC - Oregon Fire Code
    - d. 2019 OMSC - Oregon Mechanical Specialty Code
    - e. 2021 OPSC - Oregon Plumbing Specialty Code

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- f. 2019 OSSC - Oregon Structural Specialty Code
  - g. 2021 OEESC - Oregon Energy Efficiency Specialty Code
  - h. 2011 Oregon Elevator Specialty Code
- C. Reference standards and guidelines include but are not limited to the latest adopted editions from:
- 1. ABA - Architectural Barriers Act
  - 2. ADA - Americans with Disabilities Act
  - 3. AHRI - Air-Conditioning Heating & Refrigeration Institute
  - 4. ANSI - American National Standards Institute
  - 5. ASCE - American Society of Civil Engineers
  - 6. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers
  - 7. ASHRAE Guideline 0, the Commissioning Process
  - 8. ASME - American Society of Mechanical Engineers
  - 9. ASPE - American Society of Plumbing Engineers
  - 10. ASSE - American Society of Sanitary Engineering
  - 11. ASTM - ASTM International
  - 12. AWWA - American Water Works Association
  - 13. CFR - Code of Federal Regulations
  - 14. CGA - Compressed Gas Association
  - 15. CISPI - Cast Iron Soil Pipe Institute
  - 16. ETL - Electrical Testing Laboratories
  - 17. EPA - Environmental Protection Agency
  - 18. FM - FM Global
  - 19. IAPMO - International Association of Plumbing and Mechanical Officials
  - 20. GAMA - Gas Appliance Manufacturers Association
  - 21. HI - Hydraulic Institute Standards
  - 22. ISO - International Organization for Standardization
  - 23. MSS - Manufacturers Standardization Society
  - 24. NEC - National Electric Code
  - 25. NEMA - National Electrical Manufacturers Association
  - 26. NFGC - National Fuel Gas Code
  - 27. NFPA - National Fire Protection Association
  - 28. NRCA - National Roofing Contractors Association
  - 29. NSF - National Sanitation Foundation
  - 30. OSHA - Occupational Safety and Health Administration
  - 31. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association, Inc.
  - 32. TEMA - Tubular Exchanger Manufacturers Association
  - 33. TIMA - Thermal Insulation Manufacturers Association
  - 34. UL - Underwriters Laboratories Inc.
- D. See Division 22, Plumbing individual Sections for additional references.

#### **1.04 SUBMITTALS**

- A. See Division 01, General Requirements for Submittal Procedures as well as specific individual Division 22, Plumbing Sections.
- B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.
- C. In addition:
  - 1. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will

confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.

2. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via zip file via e-mail. For electronic format, provide one file per division containing one bookmarked PDF file with each bookmark corresponding to each Specification Section. Arrange bookmarks in ascending order of Specification Section number. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. All transmissions/submissions to be submitted to Architect. At Contractor's option, two separate submittals may be provided, consisting of underground work and building work. Deviations will be returned without review.
3. Product Data: Provide Manufacturer's descriptive literature for products specified in Division 22, Plumbing Sections.
4. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the Specifications and Drawings.
  - a. Label submittal to match numbering/references as shown in Contract Documents and schedules. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
  - b. Include technical data, installation instructions and dimensioned drawings for products, fixtures, equipment and devices installed, furnished or provided. Reference Division 22, Plumbing Sections for specific items required in product data submittal outside of these requirements.
  - c. Provide pump curves, operation characteristics, capacities, ambient noise criteria, etc. for equipment.
  - d. For vibration isolation of equipment, list make and model selected with operating load and deflection. Indicate frame type where required. Submit manufacturer's product data.
  - e. See Division 22, Plumbing Sections for additional submittal requirements outside of these requirements.
5. Maximum of two reviews of complete submittal package. Arrange for additional reviews and/or early review of long-lead items; Bear costs of additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.
6. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer's comments. Identify Engineer's comments and provide an individual response to each of the Engineer's comments. Cloud changes in the submittals and further identify changes which are in response to Engineer's comments.
7. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet ASCE 7-16 requirements for non-structural components. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.
8. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required per Division 22, Plumbing Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical submittals.
9. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.
10. Substitutions and Variation from Basis of Design:

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- a. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
  - b. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals". For any product marked "or approved equivalent", a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.
11. Shop Drawings: Provide coordinated Shop Drawings which include physical characteristics of all systems, equipment and piping layout plans, and control wiring diagrams. Reference individual Division 22, Plumbing Sections for additional requirements for Shop Drawings outside of these requirements.
- a. Provide Shop Drawings indicating sanitary and storm cleanout locations and type to Architect for approval prior to installation.
  - b. Provide Shop Drawings indicating access panel locations, size and elevation for approval prior to installation.
12. Samples: Provide samples when requested by individual Sections.
13. Resubmission Requirements:
- a. Make any corrections or change in submittals when required. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Cloud changes in the submittals.
    - 1) Resubmit for review until review indicates no exception taken or "make corrections as noted".
    - 2) When submitting drawings for Engineers re-review, clearly indicate changes on drawings and "cloud" any revisions. Submit a list describing each change.
14. Operation and Maintenance Manuals, Owner's Instructions:
- a. Submit, at one time, electronic files (PDF format) of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Include valve charts. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.
    - 1) Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
    - 2) Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, quantities, relevant to each piece of equipment: belts, motors, lubricants, and filters.
    - 3) Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub assemblies.
    - 4) Include copy of startup and test reports specific to each piece of equipment.

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- 5) Include copy of final water systems balancing log along with pump operating data.
  - 6) Include commissioning reports.
  - 7) Include copy of pressure, flow, leakage and purity test data and air and water systems test data, as applicable. Include copy of third-party and state and local jurisdiction inspection reports.
  - 8) Include copy of valve charts/schedules.
  - 9) Include Warranty per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
  - 10) Include product certificates of warranties and guarantees.
  - 11) Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.
- b. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 22 00 00, Plumbing Basic Requirements article titled "Demonstration".
  - c. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.
15. Record Drawings:
- a. Maintain at site at least one set of drawings for recording "As-constructed" conditions. Indicate on Drawings changes to original documents by referencing revision document, and include buried elements, location of cleanouts, and location of concealed mechanical items. Include items changed by field orders, supplemental instructions, and constructed conditions.
  - b. Record Drawings are to include equipment and fixture/connection schedules that accurately reflect "as constructed or installed" for project.
  - c. At completion of project, input changes to original project on CAD Drawings and make one set of black-line drawings created from CAD Files in version/release equal to contract drawings. Submit CAD Files and drawings upon substantial completion.
  - d. Provide Invert elevations and dimensioned locations for water services, building waste, and storm drainage piping below grade extending to 5-feet outside building line.
  - e. See Division 22, Plumbing individual Sections for additional items to include in record drawings.

#### 1.05 QUALITY ASSURANCE

- A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.
- B. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.
- C. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturers equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e., piping) and equipment proposed to assure that systems and equipment will fit in available space.

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Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.

- D. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.
- E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.
- F. Provide products that are UL listed.
- G. Piping Insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.
- H. All potable water system components, devices, material, or equipment containing a weighted average of greater than 0.25 percent lead are prohibited, and shall be certified in accordance with current editions of the Safe Drinking Water Act (SDWA), NSF 61 & NSF 372. Endpoint devices used to dispense water for drinking shall meet the requirements of NSF 61.
- I. ASME Compliance: ASME listed water heaters and boilers with an input of 200,000 BTUH and higher, hot water storage tanks which exceed 120 gallons, and hot water expansion tanks which are connected to ASME rated equipment or required by code or local jurisdiction.
- J. Provide safety controls required by National Boiler Code (ASME CSD 1) for boilers and water heaters with an input of 400,000 BTUH and higher.

#### **1.06 WARRANTY**

- A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Contracting and Procurement Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty in Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

#### **1.07 COORDINATION DOCUMENTS**

- A. Prior to construction, prepare and submit coordinated layout drawings (composite drawings) to coordinate installation and location of ductwork, grilles, diffusers, piping, fire sprinklers, plumbing, lights, and electrical services. Composite Drawings show services on single sheet. Key Drawings to structural column identification system. Prior to completion of Drawings, coordinate proposed installation with architectural and structural requirements, and other trades (including plumbing, HVAC, fire protection, electrical, ceiling suspension, and ceiling tile systems, etc.), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence.
- B. Prepare Drawings as follows:
  - 1. Drawings in CAD Format. CAD format release equal to design documents. Drawings to be same sheet size and scale as Contract Drawings and indicate location, size and elevation above finished floor of equipment and distribution systems.
  - 2. Review and revise, as necessary, section cuts in Contract Drawings after verification of field conditions.
  - 3. Indicate plumbing system piping including fittings, hangers, access panels, valves, and bottom of pipe elevations above finished floor.
  - 4. Indicate inverts and provision for piping that must be graded to have right-of-way over more flexible items. Drawings also to indicate proposed ceiling grid and lighting layout as shown on electrical drawings and architectural reflected ceiling drawings and HVAC

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- equipment, ductwork and piping.
5. Incorporate Addenda items and change orders.
  6. Distribute drawings to trades and provide additional coordination as requested by other trades.
- C. Advise Architect in event conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.
  - D. Verify in field exact size, location, invert, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.
  - E. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

### **1.08 WORK INCLUDED**

- A. Furnish and install sleeves, inserts and anchorage required for the installation, which are embedded in work of other trades. Sleeve, wrap and seal piping in concrete.
- B. Electrical: For plumbing trim/devices/equipment, provide, from the line voltage connection by Division 26, the low voltage electrical connections and wiring as required for complete and operable system. Includes, but is not limited to: Low voltage electrical raceway, wiring and accessories, such as step-down transformers as necessary for function of sensors and automatic valve and faucet controls. Supply step-down transformers and size wiring as recommended by manufacturer of plumbing trim/faucets requiring electrical low voltage connection.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer, including but not limited to fixtures, pumps, drains and equipment.

### **2.02 STANDARDS OF MATERIALS AND WORKMANSHIP**

- A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL or ETL listed and labeled or be approved by State, County, and City authorities prior to procurement and installation.
- B. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
- C. Hazardous Materials:
  1. Comply with local, State of Oregon, and Federal regulations relating to hazardous materials.
  2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
  3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

### **2.03 ACCESS PANELS**

- A. See Division 01, General Requirements and Division 08, Openings for products and installation requirements.
- B. Confirm Access Panel requirements in Division 01, General Requirements, Division 08, Openings and individual Division 22, Plumbing Sections. In the absence of specific requirements, comply with the following:
  1. Provide flush mounting access panels for service of systems and individual components requiring maintenance or inspection. Where access panels are located in fire-rated assemblies of building, rate access panels accordingly.



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- a. Ceiling access panels to be minimum 24-inch by 24-inch required and approved size.
- b. Wall access panels to be minimum of 12-inch by 12-inch required and approved size.
- c. Provide screwdriver operated catch.
- d. Manufacturers and Models:
  - 1) Drywall: Karp KDW.
  - 2) Plaster: Karp DSC-214PL.
  - 3) Masonry: Karp DSC-214M.
  - 4) 2 hour rated: Karp KPF-350FR.
  - 5) Milcor, Elmdor, Acudor, or approved equivalent.

### **PART 3 - EXECUTION**

#### **3.01 ACCESSIBILITY AND INSTALLATION**

- A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Install equipment requiring access (i.e., drain pans, drains, control operators, valves, motors, cleanouts and water heaters) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.
- C. Install equipment and products complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing, and coordination with other trades and disciplines.
- D. Earthwork:
  1. Confirm Earthwork requirements in Contract Documents. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
    - a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with the provisions of related earthwork Sections/divisions. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
    - b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
    - c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.
- E. Firestopping:
  1. Confirm Firestopping requirements in Division 07, Thermal and Moisture Protection. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
    - a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping, ductwork and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- F. Pipe Installation:
  1. Provide installation of piping systems coordinated to account for expansion and contraction of piping materials and building as well as anticipated settlement or shrinkage of building. Install work to prevent damage to piping, equipment, and building and its contents. Provide piping offsets, loops, expansion joints, sleeves, anchors or other means to control pipe movement and minimize forces on piping. Verify anticipated settlement and/or shrinkage of building with Project Structural Engineer. Verify construction phasing,

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type of building construction products and rating for coordinating installation of piping systems.

2. Include provisions for servicing and removal of equipment without dismantling piping.

G. Plenums:

1. Provide plenum rated materials that meet the requirements to be installed in plenums. Immediately notify Architect/Engineer of discrepancy.

**3.02 SEISMIC CONTROL**

- A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, and individual Division 22 Plumbing Sections.

B. General:

1. Earthquake resistant designs for Plumbing (Division 22) equipment and distribution, i.e. motors, plumbing systems, piping, equipment, water heaters, boilers, etc. to conform to regulations of jurisdiction having authority.
2. Restraints which are used to prevent disruption of function of piece of equipment because of application of horizontal force to be such that forces are carried to frame of structure in such a way that frame will not be deflected when apparatus is attached to a mounting base and equipment pad, or to structure in normal way, utilizing attachments provided. Secure equipment and distribution systems to withstand a force in direction equal to value defined by jurisdiction having authority.
3. Provide stamped Shop Drawings from licensed Structural Engineer of seismic bracing and seismic movement assemblies for piping equipment and water heaters. Submit Shop Drawings along with equipment submittals.
4. Provide stamped Shop Drawings from licensed Structural Engineer of seismic flexible joints for piping and crossing building expansion or seismic joints. Submit Shop Drawings along with seismic bracing details.

C. Piping:

1. Per "Seismic Restraints Manual Guidelines for Mechanical Systems" latest edition published by SMACNA or local requirements.

- D. Provide means to prohibit excessive motion of plumbing equipment during earthquake.

**3.03 REVIEW AND OBSERVATION**

- A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.

- B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:

1. Underground piping installation prior to backfilling.
2. Prior to covering walls.
3. Prior to ceiling cover/installation.
4. When main systems, or portions of, are being tested and ready for inspection by AHJ.

- C. Bear responsibility and cost to make piping accessible, to expose concealed lines, or to demonstrate acceptability of the system. If Contractor fails to notify Architect at times prescribed above, costs incurred by removal of such work are the responsibility of the Contractor.

D. Final Punch:

1. Prior to requesting a final punch visit from the Engineer, request from Engineer the Plumbing Precloseout Checklist, complete the checklist confirming completion of systems' installation, and return to Engineer. Request a final punch visit from the Engineer, upon Engineer's acceptance that the plumbing systems are ready for final punch.
2. Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

### **3.04 CONTINUITY OF SERVICE**

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
  - 1. During remodeling or addition to existing structures, while existing structure is occupied, current services to remain intact until new construction, facilities or equipment is installed.
  - 2. Prior to changing over to new service, verify that every item is thoroughly prepared. Install new piping, and wiring to point of connection.
  - 3. Coordinate transfer time to new service with Owner. If required, perform transfer during off peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum.
    - a. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
  - 4. Organize work to minimize duration of power interruption.

### **3.05 CUTTING AND PATCHING**

- A. Confirm Cutting and Patching requirements in Division 01, General Requirements. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
  - 1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
  - 2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.
  - 3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.
  - 4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing piping and devices are removed as part of this project. Where alterations disturb lawns, paving, and walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.
  - 5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

### **3.06 EQUIPMENT SELECTION AND SERVICEABILITY**

- A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.

### **3.07 DELIVERY, STORAGE AND HANDLING**

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
  - 1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust. Insulation and lining that becomes wet from improper storage and handling to be replaced before installation. Products and/or materials that become damaged due to water, dirt and/or dust as a result of improper storage to be replaced before installation.

2. Protect equipment and pipe to avoid damage. Close pipe openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
3. Protect bright finished shafts, bearing housings and similar items until in service.

### **3.08 DEMONSTRATION**

- A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Upon completion of work and adjustment of equipment and test systems, demonstrate to Owner's Authorized Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

### **3.09 CLEANING**

- A. Confirm cleaning requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Upon completion of installation, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

### **3.10 INSTALLATION**

- A. Confirm installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Install equipment and fixtures in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.
- C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
  1. Do not place equipment in sustained operation prior to initial balancing of plumbing systems.
  2. Provide pump impellers to obtain Basis of Design design capacities.
- D. Provide miscellaneous supports/metals required for installation of equipment and piping.

### **3.11 PAINTING**

- A. Confirm requirements in Division 01, General Requirements and Division 09, Finishes. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
  1. Ferrous Metal: After completion of plumbing work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces, i.e., hangers, hanger rods, equipment stands, with one coat of black asphalt for exterior or black enamel for interior, suitable for hot surfaces.

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2. In a mechanical room, on roof or other exposed areas, machinery and equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
3. See individual equipment Specifications for other painting.
4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
5. Piping: Clean, primer coat and paint exposed piping on roof or at other exterior locations with two coats paint suitable for metallic surfaces and exterior exposures. Color selected by Architect.
6. Covers: Covers such as manholes, cleanouts and the like will be furnished with finishes which resist corrosion and rust.

### 3.12 ACCESS PANELS

- A. Confirm Access Panel requirements in Division 01, General Requirements. In absence of specific requirements in Division 01, General Requirements, comply with individual Division 22, Plumbing Sections and the following:
  1. Coordinate locations/sizes of access panels with Architect prior to work. Label access panels with engraved nameplates indicating function of panel.

### 3.13 DEMOLITION

- A. Confirm Demolition requirements in Division 01, General Requirements and Division 02, Existing Conditions. In absence of specific requirements, comply with individual Sections in Division 22, Plumbing and the following:
  1. Scope:
    - a. It is the intent of these documents to provide necessary information and adjustments to plumbing system required to meet code, and accommodate installation of new work.
    - b. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access or access to different areas.
    - c. Existing Conditions: Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to exactly locate and preserve underground utilities. Replace damaged items with new material to match existing. Promptly notify Owner if utilities are found which are not shown on Drawings.
  2. Equipment: Unless otherwise directed, equipment, fixtures, or fittings being removed as part of demolition process are Owner's property. Remove other items not scheduled to be reused or relocated from job site as directed by Owner.
  3. Unless specifically indicated on Drawings, remove exposed, unused piping to behind finished surfaces (floor, walls, ceilings, etc.). Cap piping and patch surfaces to match surrounding finish.
  4. Unless specifically indicated on Drawings, remove unused equipment, fixtures, fittings, rough-ins, and connectors. Removal is to be to a point behind finished surfaces (floors, walls, and ceilings).

### 3.14 ACCEPTANCE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Sections in Division 22, Plumbing and the following:
  1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
    - a. Testing and Balancing Reports
    - b. Cleaning
    - c. Operation and Maintenance Manuals

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- d. Training of Operating Personnel
- e. Record Drawings
- f. Warranty and Guaranty Certificates
- g. Start-up/Test Document and Commissioning Reports

**3.15 FIELD QUALITY CONTROL**

- A. Confirm Field Quality Control requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Tests:
  - 1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in operation and maintenance manuals.
  - 2. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

**3.16 LETTER OF CONFORMANCE**

- A. Provide Letter of Conformance, copies of manufacturers' warranties and extended warranties with a statement that plumbing items were installed in accordance with manufacturer's recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in Operation and Maintenance Manuals.

**3.17 ELECTRICAL INTERLOCKS**

- A. Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, utilize plumbing equipment wiring diagrams to coordinate with electrical systems so that proper wiring of equipment involved is affected.

**END OF SECTION**

**SECTION 220519  
PLUMBING DEVICES**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Pressure Gauges
  - 2. Thermometers
  - 3. Water Hammer Arrestors (Shock Absorbers)
  - 4. Trap Primers

**1.02 RELATED SECTIONS**

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements apply to this Section.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

- A. Pressure Gauges:
  - 1. Dwyer Instruments, Inc.
  - 2. Moeller Instrument Co., Inc.
  - 3. Omega Engineering, Inc.
  - 4. Terice
  - 5. Or approved equivalent.
- B. Thermometers:
  - 1. Ashcroft
  - 2. Terice
  - 3. Weiss
  - 4. Marshalltown
  - 5. Weksler
  - 6. Or approved equivalent.
- C. Water Hammer Arrestors (Shock Absorbers):
  - 1. Bellows Type:
    - a. Amtrol
    - b. J.R. Smith
    - c. Wade
    - d. Zurn
    - e. Or approved equivalent.
  - 2. Piston Type:

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- a. PPP
  - b. Sioux Chief
  - c. Or approved equivalent.
- D. Trap Primers:
- 1. Wade
  - 2. Zurn
  - 3. J.R. Smith
  - 4. PPP
  - 5. Or approved equivalent.

## 2.02 PRESSURE GAUGES

- A. Pressure Gauges: ASME B40.100, phosphor-bronze bourdon type, dry type.
- 1. Case: Cast aluminum, stem-mounted, flange less.
  - 2. Size: 4-1/2-inch diameter.
  - 3. Window: Clear glass.
  - 4. Connector: Brass.
  - 5. Scale: White aluminum with black graduation and markings.
  - 6. Pointer: Black, adjustable.
  - 7. Mid-Scale Accuracy: One percent.
  - 8. Scale: PSI and KPa.
  - 9. Basis of Design: Trerice Model 600CB.

## 2.03 THERMOMETERS

- A. Thermometers - Adjustable Angle: Red or blue appearing organic liquid in glass, ASTM E 1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
- 1. Size: 9-inch scale.
  - 2. Window: Acrylic.
  - 3. Scale: Aluminum, white background, black graduations and markings.
  - 4. Stem: 3/4-inch NPT brass (aluminum for installation in air ducts).
  - 5. Accuracy: 2 percent, per ASTM E 77.
  - 6. Calibration: 0-160 with 2 Degrees F graduations.
  - 7. Basis of Design: Trerice BX9.

## 2.04 WATER HAMMER ARRESTORS (SHOCK ABSORBERS)

- A. Bellows-type, stainless steel casing and bellows, pressure rated, tested and certified in accordance with PDI WH-201 or ASSE 1010.
- B. Piston-type, copper, brass or stainless steel with O-ring piston, pressure rated, tested and certified in accordance with PDI WH-201 or ASSE 1010.

## 2.05 TRAP PRIMERS

- A. Trap automatic primer valve with integral anti siphon protection. Code approval required.
- B. Electronic trap seal automatic primer valve with integral anti siphon protection and timer or tied to BAS system as designated on Drawings. Coordinate quantity, locations and voltage characteristics for control points.
- C. Trap seal primer valve (low lead) with integral automatic anti-siphon protection. The priming valve to discharge on both pressure drop and pressure spike. PPP CPO 500.

## PART 3 - EXECUTION

### 3.01 GENERAL INSTALLATION REQUIREMENTS

- A. For plumbing devices requiring access from access panels (i.e. trap primers, water hammer arrestors and the like) submit location/size of all access panels to Architect for approval prior to



purchase and installation of access panel. See Section 22 00 00, Plumbing Basic Requirements for additional requirements.

- B. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- C. Install per manufacturer recommendations.

### **3.02 PRESSURE GAUGES**

- A. Install pressure gauge where exposure to heat and vibration are minimal and where the dial can be easily read. It is also important to install the gauge in a location with undisturbed and continuous flow of the pressure medium.
- B. Provide a needle valve or gauge cock, installed between the process and the pressure gauges.
- C. Install pressure gauges in piping tee with pressure gauge cock, in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- D. Locations: Install in the following locations, and elsewhere as indicated.
  - 1. At each pump inlet and outlet.
  - 2. At inlet and discharge of each pressure reducing valve.
  - 3. At make-up water service outlets.
  - 4. At inlets and outlets of all master mixing valves.
- E. Adjust gauges to final angle, clean windows and lenses, and calibrate to zero.
- F. Install per manufacturer recommendations.
- G. Pressure Gauge Range/Graduations:
  - 1. Cold Water: 0-100 PSI; graduation 1 PSI
  - 2. Hot Water: 0-100 PSI; graduation 1 PSI

### **3.03 THERMOMETERS**

- A. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2-inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- B. Install thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- C. Adjust thermometers to final angle, clean windows and lenses, and calibrate to zero.
- D. Install per manufacturer recommendations.
- E. Thermometer Range/Graduations:
  - 1. Cold Water: 25-125 degrees F; graduation 1 degree F
  - 2. Hot Water: 30-240 degrees F; graduation 2 degrees F

### **3.04 WATER HAMMER ARRESTORS (SHOCK ABSORBERS)**

- A. Install in upright position, in locations and of sizes in accordance with PDI WH-201 or ASSE 1010, and elsewhere as indicated.
- B. Locate shock absorbers in supply pipe in accordance with recommendations of Plumbing and Drainage Institute PDI-WH201 or ASSE 1010. Install ahead of solenoid operated valves. Determine size of absorber by fixture unit value of fixture supplied, using PDI symbols to designate sizes. Provide access panel for each shock absorber.
- C. Install per manufacturer recommendations.

### **3.05 TRAP PRIMERS**

- A. Flush supply line prior to installation.
- B. Install valve plumb using caution to not over tighten. Tightening to more than 55 foot-pounds can damage valve and void the warranty. Do not wrench on hex.

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- C. Effective operating range 20 to 80 PSIG (138 to 552 kPa).
- D. Do not subject trap primer valve to pressure in excess of 125 PSI.

**END OF SECTION**

**SECTION 220523**  
**GENERAL-DUTY VALVES FOR PLUMBING PIPING**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Valves, General
  - 2. Balancing Valves
  - 3. Ball Valves
  - 4. Swing Check Valves
  - 5. Backflow Prevention Assemblies
  - 6. Pressure Regulating Valve-Domestic Water
  - 7. Thermostatic Master Mixing Valves (ASSE 1017 Rated)
  - 8. Thermostatic Point-of-Use Mixing Valves (ASSE 1070 Rated)

**1.02 RELATED SECTIONS**

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. NSF 61, Annex G and/or NSF/ANSI 372 for potable water services. Valves must be 3rd-party certified.
  - 2. ISO 9001 Certified.
  - 3. IAPMO Certified for Low Lead.
- C. Source Limitations for Valves: Obtain each type of valve from a single source and from a single manufacturer.
- D. Model numbers indicated as Basis-of-Design indicate valve characteristics. All valves are to meet code Low Lead/Lead Free Standards.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

- A. Source Limitations for Valves: Obtain each type of valve from a single source and from a single manufacturer.
- B. Valves, General:
  - 1. Apollo
  - 2. Armstrong
  - 3. ASCO
  - 4. Caleffi
  - 5. Cla-Val

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6. Conbraco
  7. Crane
  8. Clow
  9. Griswold
  10. Hammond
  11. Hays
  12. Jenkins
  13. Josam
  14. Kennedy
  15. Milwaukee
  16. Mueller
  17. Nibco
  18. Red-White Valve
  19. Smith
  20. Stockham
  21. Tour Anderson
  22. Wade
  23. Watts
  24. Wilkins
  25. Zurn
  26. Or approved equivalent.
- C. Balancing Valves:
1. Caleffi
  2. Griswold
  3. Hays
  4. Armstrong CBV
  5. Tour Anderson
  6. Or approved equivalent.
- D. Ball Valves:
1. See Valves General above.
  2. NSF Valves:
    - a. Clow
    - b. Kennedy
    - c. Nibco
    - d. Or approved equivalent.
- E. Swing Check Valves:
1. See Valves General above.
- F. Backflow Prevention Assemblies:
1. Backflow Preventers:
    - a. Apollo
    - b. Cla-Val
    - c. Conbraco
    - d. Watts
    - e. Or approved equivalent.
  2. Backflow Prevention Assemblies - Reduced Pressure Zone Backflow Preventer (RPBP) for High Hazard Applications - 2-inches and Smaller:
    - a. Febco 860-with 650A.
    - b. Conbraco 40-210-AGD.
    - c. Wilkins 375-XL-SAG.
    - d. Watts 919-QT-S valve with 919AGC or 919AGF.

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- e. Or approved equivalent.
- 3. Backflow Prevention Assemblies - Double Check Valve Assembly (DCVA) for Low Hazard Applications - 2-inches and Smaller:
  - a. Febco 850-650A
  - b. Conbraco Apollo 40-110-T2
  - c. Watts 007-QT-FDA-S
  - d. Wilkins 350-S-XL
  - e. Or approved equivalent.
- 4. Spill Resistant Pressure Vacuum Breaker:
  - a. Febco
  - b. Conbraco
  - c. Watts
  - d. Wilkins
  - e. Or approved equivalent.
- 5. Atmospheric Vacuum Breakers:
  - a. Febco
  - b. Conbraco
  - c. Watts
  - d. Wilkins
  - e. Or approved equivalent.
- G. Pressure Regulating Valve-Domestic Water:
  - 1. Cash Acme
  - 2. Cla-Val
  - 3. Watts
  - 4. Wilkins
  - 5. Or approved equivalent.
- H. Thermostatic Master Mixing Valves (ASSE 1017 Rated):
  - 1. Caleffi
  - 2. Holby Tempering Valve
  - 3. Lawler Series 66
  - 4. Leonard Type TM
  - 5. Powers LFMM430 (Lead Free)
  - 6. Symmons Temp Control Series 5
  - 7. Or approved equivalent.
- I. Thermostatic Point-of-Use Mixing Valves (ASSE 1070 Rated):
  - 1. Caleffi
  - 2. Lawler
  - 3. Leonard
  - 4. Powers Hydroguard
  - 5. Or approved equivalent.

## 2.02 VALVES - GENERAL

- A. General:
  - 1. Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size.
  - 2. Operators: Provide handwheels, fastened to valve stem, for valves other than quarter-turn. Provide lever handle for quarter-turn valves 6-inches and smaller. Provide gear operators for quarter-turn valves 8-inches and larger and plug valves installed over 5-feet above finished floor.
  - 3. Valve Identification: Manufacturer's name (or trademark) and pressure rating clearly marked on valve body.
- B. Valves in Insulated Piping: With 2-inch stem extension and following features:

1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation on valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied.
- C. Valve-End Connections:
  1. Flanged: With flanges according to ASME B16.1 for iron valves.
  2. Solder Joint: With sockets according to ASME B16.18.
  3. Threaded: With thread according to ASME B1.20.1.
- D. Valve Bypass and Drain Connections: MSS SP-45.
- E. Building Service:
  1. Shutoff and Isolation Valves:
    - a. Pipe Sizes 3-inches and Smaller: Ball Valve.
  2. Drain Service: Ball Valves.
  3. Strainer Blow-Off: Ball Valve.
  4. Check Valves: Swing.

### **2.03 BALANCING VALVES**

- A. Maximum 125 PSIG System Working Water Pressure.
- B. Manual Set Balancing Valves:
  1. Valves are to be of the "Y" pattern, equal percentage globe-style and provide three functions:
    - a. Precise flow measurement.
    - b. Precision flow balancing.
    - c. Positive drip-tight shut-off.
  2. Valve to provide multi-turn, 360 degree adjustment with micrometer type indicators located on the valve handwheel. Valves have a minimum of five full 360 degree handwheel turns. 90 degree circuit-setter style ball valves are not acceptable. Valve handle to have hidden memory feature, which will provide a means for locking the valve position after the system is balanced. Valves to be furnished with precision machined venturi built into the valve body to provide highly accurate flow measurement and flow balancing. The venturi to have two 1/4-inch threaded brass metering ports with check valves and gasketed caps located on the inlet side of the valve. Valves to be furnished with flow smoothing fins downstream of the valve seat and integral to the forged valve body to make the flow more laminar. The valve body, stem and plug to be brass. The handwheel to be high-strength resin.
  3. 2-1/2-inch and Larger: Valves are to be of the "Y" pattern, equal percentage globe-style and provide three functions:
    - a. Precise flow measurement.
    - b. Precision flow balancing.
    - c. Positive drip-tight shut off. Valve to provide multi-turn, 360 degree adjustment with micrometer type indicators location on the valve handwheel. Valves to have a minimum of five full 360 degree handwheel turns. 90 degree circuit-setter style ball valves are not acceptable. Valve handle to have hidden memory feature, which will provide a means for locking the valve position after the system is balanced. Valve body to be either cast iron with integrated cast iron flanges (2-1/2-inch to 12-inch) or ductile iron with industrial standard grooved ends (2-1/2-inch to 12-inch). Valve stem and plug disc to be bronze with handwheel that permits multi-turn adjustments. Sizes 2-1/2-inch and 3-inch: five turns; sizes 4-inch to 6-inch: 6 turns; sizes 8-inch to 10-inch: 12 turns; and size 12-inch: 14 turns. Flange adapters to be provided to prevent rotation.

### **2.04 BALL VALVES**

- A. All ball valves on brazed piping are to be three-piece.

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- B. 2-1/2 Inches and Smaller: MSS SP-110, 400-600 PSI, two-piece full port ball configuration, bronze body, extended soldered ends for copper pipe and threaded ends for iron pipe, lead-free brass or stainless steel ball, lead-free brass stem, Teflon seat, extended steel handle. Apollo 77CLF 100 Series two-piece.
- C. 3 Inches and Larger: MSS SP-110, 400-600 PSI, three-piece full port ball configuration, bronze body, extended soldered ends for copper pipe and threaded ends for iron pipe, lead-free brass or stainless steel ball, lead-free brass stem, Teflon seat, extended steel handle. Apollo 82-100/82A 140 Series three-piece.
- D. Full Port Ball Valve: 2- to 4-inch ductile iron, ASTM A536, micro finish steel chrome plated or stainless steel ball and stem. TFE seats, 600 PSI.

## **2.05 SWING CHECK VALVES**

- A. 2-inches and Smaller: Class 125, bronze body, horizontal swing, regrinding type, Y-pattern, renewable disc. Nibco 413. MSS SP-80.
- B. 2-1/2-inches and Larger: Class 125, iron body, bolted bonnet, horizontal swing, renewable seat and disc, flanged ends. Nibco F918. MMS SP-71.
- C. Rubber Flapper Check Valve: Horizontal or vertical upward flow installation. Working pressure to 175 PSI. Ductile iron or cast iron body. Steel reinforced Buna-N rubber flapper epoxy coating on wetted parts. MSS SP-80.
- D. Gruvlok Series 7800 Check Valve: Horizontal installation. Working pressure to 300 PSI, Type 304/302 Stainless Steel conforming to ASTM 167. Ductile body, ASTM A536, and stainless clapper, EPDM, nitrile or optional viton bumper and bonnet seals. Stainless wetted parts.

## **2.06 BACKFLOW PREVENTION ASSEMBLIES**

- A. General: Assemblies model numbers listed below are for general comparison. Project specific model numbers to be verified contractor as approved by jurisdiction where project is located.
- B. Reduced Pressure Zone Backflow Preventer (RPBP) for High Hazard Applications:
  - 1. 2-inches and Smaller: Assembly consists of shutoff ball valves in inlet and outlet, and strainer on inlet. Assemblies include test cocks and pressure-differential relief valve located between two positive seating check valves and comply with requirements of ASSE Standard 1013 and AWWA C511. Bronze construction, threaded ends, stainless steel internal parts, FDA strainer, and air gap fitting. Route pipe from air gap fitting to approved waste receptor.
  - 2. 2-1/2-inches and Larger: Assembly consists of shutoff OS&Y gate valves in inlet and outlet, and strainer on inlet. Assemblies include test cocks and pressure-differential relief valve located between two positive seating check valves and comply with requirements of ASSE Standard 1015 and AWWA C511. Epoxy coated cast iron body construction, flanged ends, stainless steel internal parts, bronze seats, and FDA strainer.
- C. Double Check Valve Assembly (DCVA) for Low Hazard Applications:
  - 1. 2-inches and Smaller: Assembly consists of shutoff ball valves in inlet and outlet, and FDS strainer on inlet. Assemblies include test cocks and two positive seating check valves and comply with requirements of ASSE Standard 1015 and AWWA C510. Bronze construction, threaded ends, and stainless steel internal parts.
  - 2. 2-1/2-inches and Larger: Assembly consists of shutoff OS&Y gate valves in inlet and outlet, and strainer on inlet. Assemblies include test cocks and two positive seating check valves and comply with requirements of ASSE Standard 1015 and AWWA C510. Epoxy coat cast iron body construction, strainer flanged ends, and stainless steel internal parts.
- D. Spill Resistant Pressure Vacuum Breaker: Watts Model 800MCQT with 777S "Y" strainer.
- E. Atmospheric Vacuum Breaker: Assembly consists of a bronze vacuum breaker body with silicone disc, and full size orifice. Device to be IAPMO listed, meet ASSE standard 1001, and ANSI standard A113.1.1 rough chrome plate finish.

## **2.07 PRESSURE REGULATING VALVE-DOMESTIC WATER**

- A. Water: Bronze body, diaphragm or piston type, spring actuated, with separate or integral stainless steel strainer, pressure range to suit conditions, approved for potable water use, low lead. Provide shutoff valves, pressure relief valves, unions, drain valve and bypass.
- B. Water: Automatic control pressure regulating valve, stainless steel seat, stem and spring, diaphragm actuated with brass body, hydraulic control pilots with effluent operating temperature range 32 degrees F to 180 degrees F, FDA and AWWA approved.
- C. Water: Bronze body construction, stainless steel strainer screen, thermal expansion bypass with renewable stainless steel seat and high temperature resisting diaphragm.

## **2.08 THERMOSTATIC MASTER MIXING VALVES (ASSE 1017 RATED)**

- A. Thermostatic type with bronze body construction, corrosion resistant materials, union end stops, check inlets with strainers, 0-200 degree F dial thermometer and discharge shut-off valve. Mixing valves to meet ASSE 1017.
- B. Maximum required delta temperature differential between hot water supply temperature and delivery temperature is 15 degrees F. Set valve outlet temperature per drawing requirements.
- C. Flow from the tempered water circulating pump to be split to mixing valve and building hot water heating system.

## **2.09 THERMOSTATIC POINT-OF-USE MIXING VALVES (ASSE 1070 RATED)**

- A. Thermostatic type with bronze body construction, corrosion resistant materials, union end stops, check inlets with strainers, 0-200 degree F dial thermometer and discharge shut-off valve. Mixing valves to meet ASSE 1070.
- B. Maximum required delta temperature differential between hot water supply temperature and delivery temperature is 15 degrees F. Set valve outlet temperature per drawing requirements.

## **PART 3 - EXECUTION**

### **3.01 GENERAL INSTALLATION REQUIREMENTS**

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, grooves, and weld ends.
  - 3. Set ball valves open to minimize exposure of functional surfaces.
  - 4. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
  - 1. Maintain valve end protection.
  - 2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Inspect the shipping container before unpacking to look for damage that could have occurred during transport, and report it to the transportation company immediately. After visual inspection, remove the valve from the shipping container. Make sure the faces are free of any scratches and that there is not any obvious damage to the actuator assembly or valve body.
- D. Make sure to note the valve's model number during the unpacking process. The model number will need to be provided when purchasing replacement parts.
- E. Purge and clean all piping to be connected to valve.
- F. Install per manufacturer's recommendations.
- G. Determine that the valve and its plumbing piping is adequately supported when installed. If a valve is not adequately supported, this could prevent the valve from operating and sealing correctly. Be sure that all mating flanges are in line and parallel to minimize straining on joints and valve body.



- H. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- I. Do not attempt to repair defective valves; replace with new valves.
- J. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary.
- K. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward from horizontal plane unless unavoidable. Install valve drains with hose end adapter and cap on chain for each valve that must be installed with stem below horizontal plane. Ensure installation provides full stem movement.
- L. Insulation: Where insulation is indicated, install extended stem valves, arranged in proper manner to receive insulation.
- M. Mechanical Actuators: Install with chain operators where indicated. Extend chains to 5-feet above floor and hook to clips to clear aisle passage.
- N. Stem Selection: Outside screw and yoke stems, except provide inside screw, non-rising stem where space prevents full opening of OS&Y valves.
- O. Seats: Renewable seats, except where otherwise indicated.
- P. When soldering, use paste flux that are approved by the manufacturer for use with lead free alloys.
- Q. If valve applications are not indicated on Drawings, use the following:
  - 1. Shutoff Service: Ball valves.
- R. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- S. Valves, except wafer/butterfly types, with the following end connections:
  - 1. For Copper Tubing, 2-inches and Smaller. Threaded ends except where solder-joint valve-end.
  - 2. For Copper Tubing, 2-1/2-inches to NPS 4-inches. Flanged ends except where threaded valve-end.
  - 3. For Copper Tubing: 5-inches and Larger: Flanged ends.
  - 4. For Steel Piping, 2-inches and Smaller: Threaded ends.
  - 5. For Steel Piping, 2-1/2-inches to NPS 4-inches: Flanged ends except where threaded valve-end.
  - 6. For Steel Piping, 5-inches and Larger: Flanged ends.
- T. Valve Adjusting and Cleaning:
  - 1. Inspect valves for leaks. Adjust or replace packing to stop leaks. Replace valve if leak persists.
  - 2. Valve Identification. Tag valves per Section 22 05 53, Identification for Plumbing Piping and Equipment.

### **3.02 BALANCING VALVES**

- A. See General Installation Requirements above.
- B. Install with flow in the direction of the arrow on the valve body and installed at least five pipe diameters downstream from any fitting, and at least ten pipe diameters downstream from any pump. Two pipe diameters downstream from the balancing valve should be free of any fittings. When installed, easy and unobstructed access to the valve handwheel and metering ports for adjustment and measurement are to be provided. Mounting of valve in piping must prevent sediment build-up in metering ports.

### **3.03 BALL VALVES**

- A. See General Installation Requirements above.

### **3.04 SWING CHECK VALVES**

- A. See General Installation Requirements above.
- B. Swing Check Valve Installation: Install in horizontal position with hinge pin horizontally perpendicular to centerline of pipe. Install for proper direction of flow. Only install where there are 10 pipe diameters of straight pipe upstream of valve.
- C. Ejector and Sump Pump-Discharge Check Valves:
  - 1. 2-inches and Smaller: Bronze swing or spring-loaded lift check valves with bronze disc.
  - 2. 2-1/2-inches and Larger: Rubber flapper swing check valves with lever and weight.
- D. Domestic Water and Circulation Pump Discharge Check Valves:
  - 1. 2-inches and Smaller: Bronze body, spring loaded, lead free, lift check.
  - 2. 2-1/2-inches and Larger: Wafer style, silent lift check valve, lead free.

### **3.05 BACKFLOW PREVENTION ASSEMBLIES**

- A. See General Installation Requirements above.
- B. Install where indicated, and where required by code. Where practical, locate in same room as equipment being protected.
- C. Submit product cut sheets to local AHJ for approval prior to purchase and installation.
- D. Install as close to wall as possible with clearances for access and maintenance as required by AHJ.
- E. Coordinate exact location of installation and type of backflow device serving a particular piece of equipment with AHJ and Architect prior to purchase and installation.
- F. Provide wall/floor brackets that are of fully welded, hot dipped galvanized construction, fabricated to meet field conditions. Mount backflow preventer to brackets using cadmium plated "U" type bolts and nuts.
- G. Contact local water district/backflow specialist and request backflow installation requirements. Install backflow devices per UPC and local water district/backflow specialist requirements.
- H. Route waste piping from air gap waste fitting concealed within walls to point of air gap termination at indirect waste receptor.
- I. Follow local codes for installation requirements. Pipe lines should be thoroughly flushed to remove foreign material before installing the unit. Provide a strainer ahead of backflow preventer to prevent disc from unnecessary fouling. Install valve in line with arrow on valve body pointing in the direction of flow. It is important that the valve be easily accessible to facilitate testing and servicing. Do not install in a concealed location.

### **3.06 PRESSURE REGULATING VALVE-DOMESTIC WATER**

- A. See General Installation Requirements above.
- B. Install valve in the line with arrow on valve body pointing in the direction of flow. This valve should be installed where it is accessible with sufficient clearance for cleaning, service or adjustment. Install the reducing valve before a sill cock line if possible. Before installing the reducing valve hose bibb, flush out the line to remove loose dirt and scale which might damage valve disc and seat.
- C. Horizontal installation is recommended. However, valve can be installed in a vertical position. Regulator must be installed in an accessible location to facilitate servicing the regulator.
- D. To readjust reduced pressures, loosen adjusting screw nut and turn adjusting screw clockwise to raise reduced pressure and counterclockwise to lower reduced pressure.

- E. When reducing valve is used, it makes a closed system; therefore, pressure relief protection must be provided on the downstream side of the reducing valve to protect equipment.
- F. Provide pressure relief valve and terminate discharge to indirect waste receiver.
- G. Anytime a reducing valve is adjusted, the use of a pressure gauge is recommended to verify correct pressure setting. Do not bottom out adjusting screw or spring cage.
- H. Provide inlet and outlet ball valves, and globe valve bypass. Provide pressure gauge on valve outlet.
- I. Provide pressure relief valve piped full size to indirect waste receiver or floor drain.
- J. Provide factory startup on automatic control valves.

**3.07 THERMOSTATIC MASTER MIXING VALVES (ASSE 1017 RATED)**

- A. See General Installation Requirements above.
- B. Install mixing valve per manufacturer's instruction manual.

**3.08 THERMOSTATIC POINT-OF-USE MIXING VALVES (ASSE 1070 RATED)**

- A. See General Installation Requirements above.
- B. Install mixing valve per manufacturer's instruction manual.

**END OF SECTION**

**SECTION 220529  
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Pipe Hangers and Supports for Plumbing Piping and Equipment
  - 2. Wall and Floor Sleeves
  - 3. Building Attachments
  - 4. Flashing
  - 5. Miscellaneous Metal and Materials

**1.02 RELATED SECTIONS**

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. ASCE 7-16, Minimum Design Loads for Buildings and Other Structures.
  - 2. Hanger spacing installation and attachment to meet all manufacturer's requirements and MSS SP-58.
  - 3. Terminology: As defined in MSS SP-90 "Guidelines on Terminology for Pipe Hangers and Supports".
  - 4. Install piping per SMACNA's requirements.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

**1.07 PERFORMANCE REQUIREMENTS**

- A. General - Provide pipe and equipment hangers and supports in accordance with the following:
  - 1. When supports, anchorages, and seismic restraints for equipment, and supports, anchorages, and seismic restraints for piping are not shown on the Drawings, the contractor is responsible for their design.
  - 2. Connections to structural framing are not to introduce twisting, torsion, or lateral bending in the framing members. Provide supplementary steel as required.
- B. Engineered Support Systems:
  - 1. Support frames such as pipe racks or stanchions for piping and equipment which provide support from below.
  - 2. Equipment and piping support frame anchorage to supporting slab or structure.
- C. Provide channel support systems, for piping to support multiple pipes capable of supporting the combined weight of supported systems, system contents and test water.
- D. Provide heavy-duty steel trapezes for piping to support multiple pipes capable of supporting the combined weight of supported systems, system contents and test water.

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- E. Provide seismic restraint hangers and supports for piping and equipment.
- F. Obtain approval from AHJ for seismic restraint hanger and support system to be installed for piping and equipment.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

- A. Pipe Hangers and Supports for Plumbing Piping and Equipment:
  - 1. Pipe Hangers/Supports:
    - a. B-Line Systems Inc.
    - b. Anvil International
    - c. HOLDRITE
    - d. Erico Co. Inc.
    - e. Snappitz Thermal Pipe Shield Manufacturing
    - f. Rilco Manufacturing Co. Inc.
    - g. Nelsen-Olson Inc.
    - h. Or approved equivalent.
  - 2. Channel Support Systems:
    - a. B-Line Systems Inc.
    - b. Anvil International, Anvit-Strut
    - c. Erico Hanger Co. Inc.; O-Strut Div.
    - d. Unistrut Corp.
    - e. HOLDRITE EZ-Strut Systems
    - f. Or approved equivalent.
  - 3. Thermal-Hanger Shield Inserts:
    - a. Erico Hanger Co. Inc.
    - b. Pipe Shields, Inc.
    - c. Rilco Manufacturing Co. Inc.
    - d. HOLDRITE Insulation Couplings
    - e. Or approved equivalent.
  - 4. Freestanding Roof Supports:
    - a. Miro
    - b. Nelson-Olsen Inc. / Quick "Pipe" Block
    - c. Eaton / B-Line / Dura-Blok
    - d. Mifab
    - e. Or approved equivalent.
  - 5. Pipe Alignment and Secondary Supports:
    - a. HOLDRITE
    - b. Starquick
    - c. Or approved equivalent.
- B. Wall and Floor Sleeves:
  - 1. Below Grade and High Water Table Areas:
    - a. Modular Link Sealing System at Pipe Sleeves:
      - 1) Thunderline Corporation
      - 2) Or approved equivalent.
  - 2. Pre-Engineered Firestop Pipe Penetration Systems:
    - a. HOLDRITE HydroFlame
    - b. Proset
    - c. Or approved equivalent.
- C. Building Attachments:
  - 1. Anchor-It
  - 2. Gunnebo Fastening Corp.

3. ITW Ramset / Red Head
  4. Masterset Fastening Systems, Inc.
  5. Or approved equivalent.
- D. Flashing:
1. Fastenal
  2. Or approved equivalent.
- E. Miscellaneous Metal and Materials:
1. See Miscellaneous Metal and Materials article below.
  2. Powder-Actuated Fastener Systems:
    - a. Gunnebo Fastening Corp.
    - b. Hilti, Inc.
    - c. ITW Ramset / Red Head
    - d. Masterset Fastening Systems, Inc.
    - e. Or approved equivalent.

## **2.02 PIPE HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

- A. Horizontal Piping Hangers and Supports - Horizontal and Vertical Piping, and Hanger Rod Attachments:
1. Factory fabricated horizontal piping hangers and supports to suit piping systems in accordance manufacturer's published product information.
  2. Use only one type by one manufacturer for each piping service.
  3. Select size of hangers and supports to exactly fit pipe size for bare piping and to exactly fit around piping insulation with saddle or shield for insulated piping.
  4. Provide copper-plated hangers and supports for uninsulated copper piping systems.
  5. Provide padded pipe hangers, clamps and supports for thermoplastic piping system.
  6. Install no hub cast iron pipe and fittings per CISPI 301-09 Installation Procedures for Hubless Cast Iron Pipe and Fittings for Sanitary and Storm Drain Waste and Vent Piping Applications. Brace hubless cast iron pipe and fittings 5-inch and larger with HOLDRITE No Hub Pipe Restraints or approved equivalent.
- B. Pipe Hangers, Guides and Channel Systems:
1. Hanger Rods: Hanger rods continuously threaded or threaded ends only in concealed spaces and threaded ends only in exposed spaces; finish electro-galvanized or cadmium-plated in concealed spaces and prime painted in exposed spaces; sizes per MSS.
  2. Hanger Rod Couplings: Malleable iron rod coupling with elongated center sight gap for visual inspection; to have same finish as hanger rods.
  3. Pipe Rings for Hanger Rods: Pipe sizes 2-inch and smaller, MSS SP Type 6 or Type 10, or approved equivalent. Pipe sizes 2-1/2-inches and larger, clevis type hangers with adjustable nuts on rod. MSS SP Type 1. Pipe rings to have same finish as hanger rods.
  4. Pipe Slides: Type 35 reinforced Teflon slide material (3/32-inch minimum thickness) bonded to steel; highly finished steel or stainless steel contact surfaces to resist corrosion; 60-80 PSI maximum active contact surface loading; steel parts 3/16-inch minimum thickness; attachment to pipe and framing by welding.
  5. Pipe Guides:
    - a. Furnish and install pipe guides on continuous runs where pipe alignment must be maintained. Minimum two on each side of expansion joints, spaced per manufacturer's recommendations for pipe size. Fasten guides securely to pipe and structure. Any contact with chilled water pipe is not to permit heat to be transferred in sufficient quantity to cause condensation on any surface.
    - b. Furnish and install guides approximately 4 pipe diameters (first guide) and 14 diameters (second guide) away from each end of expansion joints. Guides are not to be used as supports and are in addition to other pipe hangers and supports.

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6. Channel Type Pipe Hanging System: Framing members No. 12 gauge formed steel channels, 1-5/8-inch square, conforming to ASTM A1011 GR33; one side of channel to have a continuous slot with in-turned lips; framing nut with grooves and spring 1/2-inch size, conforming to ASTM 675 GR60; screws conforming to ASTM A307; fittings conforming to ASTM A575; parts enamel painted or electro-galvanized.
- C. Pipe Saddles and Shields:
  1. Factory fabricated saddles or shields under piping hangers and supports for insulated piping.
  2. Size saddles and shields for exact fit to mate with pipe insulation. 1/2 round, 18 gauge, minimum 12-inches in length (4-inch pipe and larger to be three times longer than pipe diameter).
- D. Thermal-Hanger Shield Inserts: 100-PSI (690-kPa) minimum compressive strength insulation, encased in sheet metal shield.
  1. Material for Cold Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with vapor barrier.
  2. Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate.
  3. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
  4. For Clevis or Band Hanger: Insert and shield to cover lower 180 degrees of pipe.
  5. Insert Length: Extend 2-inches beyond sheet metal shield for piping operating below ambient air temperature.
  6. Thermal Hanger Shield Inserts should be provided at the hanger points and guide locations on pipes requiring insulation. The Inserts should consist of Polyisocyanurate (urethane or phenolic insulation) encircling the entire circumference of the pipe with a 360 degree PVC (1.524 mm thick) with a living hinge and J lock and installed during the installation of the piping system.
- E. Roller Hangers:
  1. Adjustable roller hanger. Black steel yoke, cast iron roller. MSS Type 41.
- F. Concrete Inserts:
  1. Malleable iron body, hot dipped galvanized finish. Lateral adjustment. MSS Type 18.
- G. Continuous Concrete Insert:
  1. Steel construction, minimum 12 gauge. Electrogalvanized finish. Pipe clamps and insert nuts to match.
- H. Beam Clamps:
  1. MSS Type 19 and 23, wide throat, with retaining clip.
  2. Universal Side Beam Clamp: MSS Type 20.
- I. Below Ground:
  1. Pipe Hangers: Adjustable Clevis type, Federal Specification WW-H-171 (Type 1), UL listed, stainless steel Type 316. MSS Type 1. If PVC piping to be used, provide Type 1 hanger, coated for PVC piping.
  2. Rod: 5/8-inch stainless steel Type 316.
  3. Eyebolt: Stainless steel Type 316.
  4. Nuts and Washers: Stainless steel Type 316.
- J. Hangers for Pipe Size 2-inches and Smaller:
  1. Adjustable swivel ring hanger, UL listed, Type 6 or Type 10.
- K. Hangers for Pipe Size 2-1/2-inches and Larger:
  1. Adjustable clevis type, UL listed, Type 1.
- L. Riser Clamps:
  1. Steel, UL listed. MSS Type 8.
- M. Plumbers Tape:

1. Not permitted as pipe hangers or pipe straps.
- N. Pipe Alignment and Secondary Support Systems:
1. Secondary Pipe supports for general applications (Non-Acoustical).
    - a. Supports will be manufactured in compliance with IAPMO Product Standard PS 42-96. All products provided will be listed by IAPMO for secondary pipe support.
    - b. Supports may be used when sound and/or vibration transfer is not a concern.
  2. Secondary pipe supports for sound and vibration attenuation (Acoustical).
    - a. Supports will be manufactured in compliance with IAPMO Product Standard PS 42-96. All products provided will be listed by IAPMO for secondary pipe support.
    - b. Acoustical pipe supports will be manufactured and installed in compliance with International Organization for Standardization (ISO) 3822-1 with current amendments.
    - c. Supports will be used when sound and/or vibration transfer is a concern. Locations where acoustical supports will be provided and include but are not limited to partition walls between living units, tenant spaces, retail units, mechanical rooms and lobbies.
    - d. Support Products:
      - 1) Support to Wall Brace and Wall Stud Penetrations: HOLDRITE #261, #262, #263, and #264, or approved equivalent.
      - 2) Pipe Wrap for Pipe Clamps and Channel-Mounted Pipe Clamps: HOLDRITE #270, or approved equivalent.
      - 3) Pipe Wrap for Pipe Hangers: HOLDRITE #271, #272-2, and #272-4, or approved equivalent.
      - 4) Drop-Ear Fitting Support: HOLDRITE #265, or approved equivalent.
      - 5) Floor Riser Isolation Pads: HOLDRITE #275-T, or approved equivalent.
      - 6) Floor Isolation Pads (General Applications): HOLDRITE #274, #275, #276, and #278, or approved equivalent.
- O. Freestanding Roof Pipe Supports:
1. Polyethylene high-density UV resistant block with foam pad or 100 percent UV resistant recycled rubber. With galvanized strut/channel.

### 2.03 WALL AND FLOOR SLEEVES

- A. Below Grade and High Water Table Areas:
1. Modular Link Sealing System at Pipe Sleeves: Neoprene gasket links bolted together around an interior sleeve forming a watertight seal. Use a modular link sealing system at sleeves to continuously fill the annular space between the pipe and the wall opening. Provide Link-seal Type C unless otherwise noted. OS with S-316 stainless construction for continuous water/tank walls.
  2. Sleeves through concrete foundation walls and floors. Ductile iron pipe. Class 50 or 51 pipe conforming to ANSI/AWWA C151/A21.51. Pipe sleeve will extend a minimum of 6-inches beyond outside perimeter of foundation. Final placement of sleeve will be confirmed with project's structural engineer. In areas with a high water table, provide AWWA C900, Class 235 plastic pipe in lieu of ductile iron pipe.
- B. Pre-Engineered Firestop Pipe Penetration Systems: UL listed assemblies for maintaining fire rating of piping penetrations through fire-rated assemblies. Comply with ASTM E814.
- C. Insulating Caulking: Eagle or Pitcher Super 66 high temperature cement.
- D. Fabricated Accessories:
1. Steel Pipe Sleeves: Fabricate from Schedule 40 black or galvanized steel pipe. Remove end burrs by grinding.
  2. Sheet Metal Pipe Sleeves: Fabricate from G-90 galvanized sheets closed with lock-seam joints. Provide following minimum gauges for sizes indicated:
    - a. Sleeve Size 4-inches in Diameter and Smaller: 18 gauge.
    - b. Sleeve Sizes 5-inches to 6-inches: 16 gauge.



- c. Sleeve Sizes 7-inches and Larger: 14 gauge.
- d. Fire-Rated Safing Material:
  - 1) Rockwool Insulation: Complying with FS-HH-I-558, Form A, Class IV, 6 lbs./cu.ft. density with melting point of 1985 degrees F and K value of 0.24 at 75 degrees F.
  - 2) Calcium Silicate Insulation: Noncombustible, complying with FS-HH-I-523, Type II, suitable for 100 degrees F to 1200 degrees F service with K value of 0.40 at 150 degrees F.

#### **2.04 BUILDING ATTACHMENTS**

- A. General: Anchor supports to existing masonry, block and tile walls per anchoring system manufacturer's recommendations or as modified by project Structural Engineer. Provide anchor bolts suitable for cracked concrete.
- B. Anchor Bolts:
  - 1. Anchor Bolts (Cast-In-Place): Steel bolts, ASTM A307. Nuts to conform to ASTM A194. Design values for shear and tension not more than 80 percent of the allowable listed loads.
  - 2. Anchor (Expansion) Bolts: Carbon steel to ASTM A307; nut to conform to ASTM A194; drilled-in type. Design values for shear and tension not more than 80 percent of the allowable listed loads.
  - 3. Anchor (Adhesive) Bolts: Consisting of two-part adhesive cartridge and zinc-plated Type A307 steel anchor bolt rod assembly with ASTM A194 nut.
- C. Beam Clamps:
  - 1. MSS Type 19 and 23, wide throat, with retaining clip.
  - 2. Universal Side Beam Clamp: MSS Type 20.
- D. Powder-Actuated Drive Pin Fasteners:
  - 1. Powder-Actuated Drive-Pin Fasteners: Powder actuated type, drive pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- E. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- F. Grout: ASTM C1107, Grade B, factory mixed and packaged, non-shrink and nonmetallic, dry, hydraulic-cement grout.
  - 1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
  - 2. Properties: Non-staining, noncorrosive, and non-gaseous.
  - 3. Design Mix: 5000-PSI (34.5-MPa), 28-day compressive strength.

#### **2.05 FLASHING**

- A. Steel Flashing: 26 gauge galvanized steel.
- B. Safes: 8 mil thick neoprene.
- C. Caps: Steel, 22 gauge minimum, 16 gauge at fire-resistant structures.
- D. Provide hot dipped galvanized components for items exposed to weather.

#### **2.06 MISCELLANEOUS METAL AND MATERIALS**

- A. Miscellaneous Metal: Provide miscellaneous metal items specified hereunder, including materials, fabrication, fastenings and accessories required for finished installation, where indicated on Drawings or otherwise not shown on drawings, that are necessary for completion of the project. The Contractor is responsible for their design.
  - 1. Fabricate miscellaneous units to size, shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of

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welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.

- B. Structural Shapes: Where miscellaneous metal items are needed to be fabricated from structural steel shapes and plates, provide members constructed of steel conforming with requirements of ASTM A36 or approved equivalent.
- C. Steel Pipe: Provide seamless steel pipe conforming to requirements of ASTM A53, Type S, Grade A, or Grade B. Weight and size required as specified.
- D. Fasteners: Provide fasteners of types as required for assembly and installation of fabricated items; surface-applied fasteners are specified elsewhere.
- E. Bolts: Low carbon steel externally and internally threaded fasteners conforming with requirements of ASTM A307; include necessary nuts and plain hardened washers. For structural steel elements supporting mechanical material or equipment from building structural members or connection thereto, use fasteners conforming to ASTM A325.
- F. Miscellaneous Materials: Provide incidental accessory materials, tools, methods and equipment required for fabrication.
- G. Provide hot dipped galvanized components for items exposed to weather.
- H. Use straps, threshold rods and wire with sizes required by SMACNA to support piping.
- I. Grout: ASTM C1107, Grade B, factory mixed and packaged, non-shrink and nonmetallic, dry, hydraulic-cement grout.
  - 1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
  - 2. Properties: Non-staining, noncorrosive, and non-gaseous.
  - 3. Design Mix: 5000-PSI (34.5-MPa), 28-day compressive strength.

### **PART 3 - EXECUTION**

#### **3.01 GENERAL INSTALLATION REQUIREMENTS**

- A. Examination:
  - 1. Verify building materials to have hangers and attachments affixed in accordance with hangers to be used. Provide supporting calculations.
- B. Preparation:
  - 1. Examine Drawings and coordinate for verification of exact locations of fire and smoke rated walls, partitions, floors and other assemblies. Indicate, by shading and labeling on Record Drawings such locations and label as "1-Hour Wall," "2-Hour Fire/Smoke Barrier," and the like. Determine proper locations for piping penetrations. Set sleeves in place in new floors, walls or roofs prior to concrete pour or grouting.
- C. Install hangers, supports, anchors and sleeves after required building structural work has been completed in areas where the work is to be installed. Coordinate with project structural engineer proper placement of inserts, anchors and other building structural attachments.

#### **3.02 PIPE HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

- A. Hangers and Supports:
  - 1. Comply with MSS SP-58. Pipe Hanger and Support Installation: Install hangers, supports, clamps, and attachments as required to properly support piping from building structure. For horizontally hung grooved-end piping, provide a minimum of 2 hangers per pipe section.
  - 2. Pipe Ring Diameters:
    - a. Uninsulated and Insulated Pipe, except where oversized pipe rings are specified: Ring inner diameter to suit pipe outer diameter.
    - b. Insulated Piping Where Oversized Pipe Rings are Specified and Vibration Isolating Sleeves: Ring inner diameter to suit outer diameter of insulation or sleeve.
  - 3. Oversize Pipe Rings: Provide oversize pipe rings of 2-inch and larger size.

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4. Pipe Support Brackets: Support pipe with pipe slides.
5. Steel Backing in Walls: Provide steel backing in walls to support fixtures and piping hung from steel stud walls.
6. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
  - a. Field assemble and install according to manufacturer's written instructions.
7. Pipe Guides:
  - a. Install on continuous runs where pipe alignment must be maintained. Provide a minimum of two on each side of expansion joints, spaced per manufacturer's recommendations for pipe size. Fasten guides to pipe structure. Any contact with chilled water pipe should not permit heat to be transferred in sufficient quantity to cause condensation on any surface.
  - b. Install approximately 4 pipe diameters (first guide) and 14 diameters (second guide) away from each end of expansion joints. Do not use as supports. Provide in addition to other required pipe hangers and supports.
8. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes.
  - a. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
  - b. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1
9. Group parallel runs of horizontal piping to be supported together on trapeze-type hangers.
10. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe.
11. Do not support piping from other piping.
12. Fire protection piping will be supported independently of other piping.
13. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated.
14. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories.
15. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchor, and to facilitate the action of expansion joints, expansion loops, expansion bends and similar units.
16. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
17. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping" is not exceeded.
18. Insulated Piping: (comply with the following)
  - a. Attach clamps and spacers to piping.
    - 1) Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - 2) Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - 3) Do not exceed pipe stress limits according to ASME B31.9.
  - b. Install MSS SP-58, Type 39 protection saddles, if insulation without a vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - 1) Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN100) and larger if pipe is installed on rollers.
  - c. Install MSS SP-58, Type 40 protective shields on cold piping having a vapor barrier. Shields to span arc of 180 degrees.

- 1) Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN100) and larger if pipe is installed on rollers.
  - d. Shield Dimensions for Pipe, not less than the following:
    - 1) NPS 1/4 to NPS 3-1/2 (DN8 to DN 90): 12-inches long and 0.048-inch thick.
    - 2) NPS 4 (DN100): 12-inches long and 0.06-inch thick.
    - 3) NPS 5 and NPS 6 (DN125 and DN150): 18-inches long and 0.06-inch thick.
    - 4) NPS 8 to NPS 14 (DN200 to DN350): 24-inches long and 0.075-inch thick.
    - 5) NPS 16 to NPS 24 (DN400 to DN600): 24-inches long and 0.105-inch thick.
  - e. Pipes NPS 8 (DN200) and Larger: Include wood inserts.
  - f. Insert Material: Length at least as long as protective shield.
  - g. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
  19. Equipment Clearances: Do not route equipment or piping through electrical rooms, transformer vaults, elevator equipment rooms, IT rooms, MPOE rooms, or other electrical or electronic equipment spaces and enclosures and the like. Within equipment rooms, provide minimum 3-foot lateral clearance from all sides of electric switchgear panels. Do not route piping or equipment above any electric power or lighting panel, switchgear, or similar electric device. Coordinate with Electrical and coordinate exact equipment or pipe routing to provide proper clearance with such items.
  20. Pipe supports and hanger spacing (pipe supported from structure or floor-supported) to meet the requirements of References and Standards Article in Part 1 above.
- B. Pipe Curb Assemblies:
1. Provide for piping and electrical conduit which penetrates the structural roof deck to service equipment above the roof level (e.g., piping, electrical power and control wiring). Meet requirements of roof warranty.
  2. Provide prefabricated units for roof membrane and insulation penetrations related to equipment. Coordinate with roofing system. Set supports on the structural deck. Do not set supports on insulation or roofing. Provide level supports by prefabricated pitch built into the curb.
  3. Piping above roof to be supported with freestanding roof pipe supports unless detailed otherwise. At roofing applications, the adhesion mastic is to be specifically submitted to and approved by the roofing system manufacturer/installer to maintain the integrity of all warranties.
  4. At concrete floors, install a polyurethane mastic to the support block and adhere in place.
- C. Vertical Piping:
1. Support with U-clamps fastened to wall to hold piping away from wall unless otherwise approved.
  2. Riser clamps to be directly under fitting or welded to pipe. Provide neoprene pads for all systems except natural gas.
  3. Riser to be supported at each floor penetration.
  4. Provide structural steel supports at the base of pipe risers. Size supports to carry forces exerted by piping system when in operation.
- D. Adjusting and Painting:
1. Adjust hangers so as to distribute loads equally on attachments. Provide grout under supports to bring piping and equipment to proper level and elevations.
  2. Prime paint ferrous nongalvanized hangers, accessories, and supplementary steel which are not factory painted.

### 3.03 WALL AND FLOOR SLEEVES

- A. "Link-Seal" Pipe Sleeves: Install at slab on grade floor/below grade piping penetrations. Provide manufacturer's sleeve appropriate to seal type for pre-cast penetrations (except for DWV piping at slab on grade). Provide manufacturer's sleeve appropriate to seal type for pre-cast penetrations.

- B. Fabricated Pipe Sleeves:
  - 1. Provide either steel or sheet metal pipe sleeves accurately centered around pipe routes. Size such that piping and insulation, if any, will have free movement within the sleeve, including allowance for thermal expansion. Sleeve diameter to be determined by local seismic clearance requirement, and by waterproofing requirements.
  - 2. Length: Equal to thickness of construction penetrated, except extend floor sleeves 1-inch above floor finish.
  - 3. Provide temporary support of sleeves during placement in concrete and other work around sleeves. Provide temporary end closures to prevent concrete and other materials from entering pipe sleeves.
  - 4. Seal each end airtight with a resilient nonhardening sealer, UL listed and fire rated per ASTM 814.

### 3.04 BUILDING ATTACHMENTS

- A. Install within concrete slabs or attach to structural steel or wood. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints and at changes in direction of piping.
- B. Attachment to Wood Structure: Provide MSS Type 34 for attachment to wooden beam or approved attachment for a wood structure.
- C. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- D. Install concrete inserts before concrete is placed; fasten insert secure to forms. Where concrete with compressive strength less than 2500 PSI is indicated, install reinforcing bars through openings at top in inserts.
- E. Install powder-actuated drive pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Test powder-actuated insert attachments with a minimum load of 100 pounds.
- F. Bolting: Provide bored, drilled or reamed holes for bolting to miscellaneous structural metals, frames or for mounts or supports. Flame cut, punched or hand sawn holes will not be accepted.
- G. Anchor Bolts:
  - 1. Install anchor bolts for mechanical equipment and piping as required. Tightly fit and clamp base-supported equipment anchor bolts at equipment support points. Provide locknuts where equipment and piping are hung.
  - 2. Anchor Bolts (Cast-In-Place): Embed anchor bolts in new cast-in-place concrete to anchor equipment. Install a pipe sleeve around the anchor bolt for adjustment of the top 1/3 of the bolt embedment; sizes and patterns to suit the installation conditions of the equipment to be anchored.
- H. Pipe Anchors: Provide anchors to fasten piping which is subject to expansion and contraction, and adjacent to equipment to prevent loading high forces onto the equipment.
- I. Escutcheon Plates: Install around horizontal and vertical piping at visible penetrations through walls, partitions, floors, or ceilings, including penetrations through closets, through below ceiling corridor wall, and through equipment room walls and floors.
- J. Installation of metallic or plastic piping penetrations through non fire-rated walls and partitions and through smoke-rated walls and partitions:
  - 1. Install fabricated pipe sleeve.
  - 2. After installation of sleeve and piping, tightly pack entire annular void between piping or piping insulation and sleeve identification with specified material.
  - 3. Seal each end airtight with a resilient nonhardening UL listed fire resistant ASTM 814 sealant.

- K. Piping Penetrations Through Fire-Rated (1 to 3 hour) Assemblies:
  - 1. Select and install pre-engineered pipe penetration system in accordance with the UL listing and manufacturer's recommendation.
  - 2. Provide proper sizing when providing sleeves or core-drilled holes to accommodate the penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet the requirements of ASTM E814. Use HOLDRITE HydroFlame or approved equivalent.
- L. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories.

### **3.05 FLASHING**

- A. Flash and counter flash where piping passes through weather or waterproofed walls, floors and roofs.
- B. Flash vent soil pipes with flashings per Division 01, General Requirements.
- C. Flash floor drains over finished areas and roof drains, 10-inches clear on sides, minimum 36-inches by 36-inches sheet size. See Division 01, General Requirements. Fasten flashing to drain with clamping device.
- D. Install built up fixtures (mop sinks, shower stalls, shower floors) with water sealing systems/membranes to meet Code and as prescribed by Division 01, General Requirements and Section 22 00 00, Plumbing Basic Requirements. Meet all Code testing requirements. Provide drainage devices with appropriate flanges, clamps, etc. to meet these installation requirements and ensure a water-tight installation.

### **3.06 MISCELLANEOUS METAL AND MATERIALS**

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.
- B. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including, threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required. Avoid cutting concrete reinforcing when drilling for inserts. Reference structural drawings and reinforcing shop drawings and determine locations of stirrups prior to drilling into concrete.
- C. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete masonry or similar construction.
- D. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.
- E. Setting Loose Plates: Clean concrete and masonry bearing surfaces of any bond reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.
  - 1. Set loose leveling and bearing plates on wedges or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut-off flush with edge of the bearing plate before packing with grout. Use metallic non-shrink grout in concealed locations where not exposed to moisture; use non-metallic non-shrink grout in exposed locations, unless otherwise indicated.
  - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.
- F. Fabrication:

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1. General: Verify dimensions prior to fabrication. Form metal items to accurate sizes and configurations as indicated on Drawings and otherwise required for proper installation; make with lines straight and angles sharp, clean and true; drill, countersink, tap, and otherwise prepare items for connections with work of other trades, as required. Fabricate to detail of structural shapes, plates and bars; weld joints where practicable; provide bolts and other connection devices required. Include anchorages; clip angles, sleeves, anchor plates and similar devices. Hot dip galvanize after fabrication items installed in exterior locations. Set accurately in position as required and anchor securely to building construction. Construct items with joints formed for strength and rigidity, accurately machining for proper fit; where exposed to weather, form to exclude water.
2. Finishes:
  - a. Ferrous Metal: After fabrication, but before erection, clean surfaces by mechanical or chemical methods to remove rust, scale, oil, corrosion, or other substances detrimental to bonding of subsequently applied protective coatings. For metal items exposed to weather or moisture, galvanize in manner to obtain G90 zinc coating in accordance with ASTM A123. Provide other non-galvanized ferrous metal with 1 coat of approved rust-resisting paint primer, in manner to obtain not less than 1.0 mil dry film thickness. Touch-up damaged areas with primer of same material before installation. Apply zinc coatings and paint primers uniformly and smoothly; leave ready for finish painting as specified elsewhere.
  - b. Metal in contact with Concrete, Masonry and Other Dissimilar Materials:
    - 1) Where metal items are to be erected in contact with dissimilar materials, provide contact surfaces with coating of an approved zinc-chromate primer in manner to obtain not less than 1.0 mil dry film thickness, in addition to other coatings specified in these specifications.
  - c. For Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A780.
- G. Metal Fabrication:
  1. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.
  2. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
  3. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of weld and methods used in correcting welding work, and with the following:
    - a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
    - b. Obtain fusion without undercut or overlap.
    - c. Remove welding flux immediately.
    - d. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.
  4. Provide hot dipped galvanized components for items exposed to weather.

**END OF SECTION**

**SECTION 220553**  
**IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Plastic Nameplates
  - 2. Tags
  - 3. Plastic Pipe Markers

**1.02 RELATED SECTIONS**

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, submit Valve Schedule for each piping system, in tabular format using Microsoft Word or Excel software. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shutoff and similar special uses by special "flags" in margin of schedule. In addition to mounted copies, furnish extra copies for maintenance manuals. Provide schedules organized as follows:
  - 1. Equipment Type:
    - a. Identification:
    - b. Background:
      - 1) Size:
      - 2) Color:
    - c. Lettering:
      - 1) Size:
      - 2) Color:

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Manufacturer's Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required.
  - 2. Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices unless otherwise indicated.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 22, Plumbing Sections. Where more than a single type is specified for application, provide single selection for each product category.



- B. Plastic Nameplates:
  - 1. Brady Corporation
  - 2. Or approved equivalent.
- C. Tags:
  - 1. Brady Corporation
  - 2. Brimar
  - 3. Champion America Inc.
  - 4. Craftmark
  - 5. Seton Identification Products
  - 6. Or approved equivalent.
- D. Plastic Pipe Markers:
  - 1. Brady Corporation
  - 2. Brimar
  - 3. Champion America Inc.
  - 4. Craftmark
  - 5. Seton Identification Products
  - 6. Or approved equivalent.

## 2.02 PLASTIC NAMEPLATES

- A. Description: Engraving stock melamine plastic laminate 1/8-inch thick, engraved with engraver's standard letter style of the sizes and wording indicated.
  - 1. Letter Color: White.
  - 2. Letter Height: 1/2 inch.
  - 3. Background Color: Black.
  - 4. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
  - 5. Access Panel Markers: Manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve or devices/equipment. Include center hole to allow attachment.
  - 6. Signage for hot water outlets on 140 degree F hot water systems not protected by ASSE 1070 mixing valves; hose bibbs, janitor sinks, and fixtures used by trained personnel.
    - a. Manufacturer's standard 1/8-inch thick engraved plastic laminate signage 4 by 4-inches.
    - b. Letter Color: Red.
    - c. Letter Height: 1/2 inch.
    - d. Background Color: White.
    - e. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

## 2.03 TAGS

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2-inch diameter.
- B. Metal Tags: Polished Brass with stamped letters; tag size minimum 1-1/2-inch diameter with smooth edges.
- C. Valve designations to be coordinated with existing valve identifications to ensure no repetitive designations are utilized.
- D. Chart/Schedules: Valve Schedule Frames. For each page of a valve schedule, provide glazed display frame with removable mounting as appropriate for wall construction upon which frame is to be mounted. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.
- E. Valve Tag Fasteners: Solid brass chain (wire link or beaded type), or solid brass S-hooks.

- F. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
  - 1. Size: Approximately 4 by 7-inches.
  - 2. Fasteners: Brass grommet and wire.
  - 3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
  - 4. Color: Yellow background with black lettering.

#### **2.04 PLASTIC PIPE MARKERS**

- A. Color: Conform to ASME A13.1 and ANSI Z535.1.
- B. Plastic Pipe Markers (for external diameters of 6-inches and larger including insulation): Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Plastic Tape Pipe Markers (for external diameters less than 6-inches including insulation): Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings. Minimum information indicating flow direction arrow and identification of fluid being conveyed.

### **PART 3 - EXECUTION**

#### **3.01 GENERAL INSTALLATION REQUIREMENTS**

- A. Lettering and Graphics:
  - 1. General: Coordinate names, abbreviations and other designations used in plumbing identification work with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.
  - 2. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples: Chiller No. 3, Air Handling Unit No. 42, Standpipe F12, and the like).
- B. Preparation: Degrease and clean surfaces to receive adhesive for identification materials.
- C. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.
- D. Install valve schedule at each mechanical room.
- E. Access Doors: Provide markers on each access door and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions.

#### **3.02 PLASTIC NAMEPLATES**

- A. Identify pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates riveted to equipment body.
- B. Identify control panels and major control components outside panels with plastic nameplates riveted to equipment body.
- C. Install plastic nameplates with corrosive-resistant mechanical fasteners.

#### **3.03 TAGS**

- A. Small devices, such as in-line pumps, may be identified with tags. Use metal tags on piping 3/4-inch diameter and smaller.
- B. Identify valves in main and branch piping with metal tags. Indicate valve function and the normally open or closed positions on the valve tag.

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- C. Coordinate with the facility maintenance personnel to ensure consistency with the existing tagging system.
- D. Tag balancing valves with balanced GPM or CFM indicated after balancing is completed and accepted.
- E. Install tags with corrosion resistant chain.

**3.04 PLASTIC PIPE MARKERS**

- A. Install plastic pipe markers in accordance with manufacturer's instructions.
- B. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- C. For exterior underground piping installations, install underground plastic pipe markers with tracer wire 6 to 8-inches below finished grade directly above buried pipe.
- D. Identify piping, concealed or exposed, with plastic tape pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20-feet (reduced to 10-feet in congested areas and mechanical equipment rooms) on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction. Locate near branches, valves, control devices, equipment connections, access doors, floor/wall penetrations.

**END OF SECTION**

**SECTION 220593**  
**TESTING, ADJUSTING, AND BALANCING FOR PLUMBING**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Balancing water flow within distribution systems of all Division 22, Plumbing Sections, including sub-mains, branches, and terminals, to indicated quantities according to specified tolerances.
- B. Adjusting plumbing systems to provide indicated quantities.
- C. Verifying that automatic control devices are functioning properly.
- D. Reporting results of the activities and procedures specified in this Section.

**1.02 RELATED SECTIONS**

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Acceptable Balance Firm:
    - a. General:
      - 1) Procure services of independent Testing, Adjusting, and Balancing (TAB) agency to balance, adjust and test water circulating. Minimum Experience: 5 years.
      - 2) Industry Standards: Testing and Balancing will conform to NEBB, American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE), and American National Standards Institute (ANSI) as follows:
        - 1) NEBB: Comply with Procedural Standards for Testing, Adjusting Balancing of Environmental Systems.
        - 2) ASHRAE: Comply with recommendations pertaining to measurements, instruments, and TAB.
    - c. Test Observation: If requested, conduct tests in the presence of the Architect or the Architect's representative.
  - 2. Provide proof of testing agency having successfully completed at least five projects of similar size and scope.
  - 3. Code Compliance: Perform tests in the presence of the Authority Having Jurisdiction (AHJ) where required by the Authority Having Jurisdiction (AHJ).
  - 4. Owner Witness: Perform tests in the presence of the Owners representative.
  - 5. Engineer Witness: The engineer or engineer's representative reserves the right to observe tests or selected tests to assure compliance with the specifications.
  - 6. Simultaneous Testing: Test observations by the Authority Having Jurisdiction (AHJ), the Owner's Authorized Representative and the engineer's representative need not occur simultaneously.
  - 7. Do not perform TAB work until plumbing equipment has been completely installed and is operating continuously as required.
  - 8. Conduct TAB with clean filters in place. Clean strainers prior to performing TAB.

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9. Agent Qualifications: Engage a TAB Agent certified by AABC or NEBB.
10. TAB Conference: Meet with the Owner's and the Architect's representatives on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, controls Installer, and other support personnel. Provide 7 days advance notice of scheduled meeting time and location.
  - a. Agenda Items: Include at least the following:
    - 1) Submittal distribution requirements.
    - 2) TAB plan.
    - 3) Work schedule and Project site access requirements.
    - 4) Coordination and cooperation of trades and subcontractors.
    - 5) Coordination of documentation and communication flow.
11. Certification of TAB Reports: Certify the TAB field data reports. This certification includes the following:
  - a. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
  - b. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
12. TAB Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing."
13. TAB Reports: Use standard forms from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
14. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards.
15. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
16. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

#### **1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

#### **1.07 DEFINITIONS**

- A. Adjust: To regulate fluid flow rate at the equipment.
- B. Balance: To proportion flows within the distribution system, including sub mains, branches, and terminals, according to design quantities.
- C. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- D. Report Forms: Test data sheets for recording test data in logical order.
- E. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- F. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- G. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- H. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- I. TAB: Testing, Adjusting, and Balancing.
- J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

- K. Test: A procedure to determine quantitative performance of a system or equipment.
- L. Testing, Adjusting, and Balancing (TAB) Agent: The entity responsible for performing and reporting the TAB procedures.
- M. AABC: Associated Air Balance Council.
- N. AMCA: Air Movement and Control Association.
- O. CTI: Cooling Tower Institute.
- P. NEBB: National Environmental Balancing Bureau.
- Q. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

### **1.08 COORDINATION**

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, controls installers, and other mechanics to operate systems and equipment to support and assist TAB activities.
- B. Notice: Provide 7 days advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on piping distribution systems have been satisfactorily completed.

## **PART 2 - PRODUCTS - NOT USED**

## **PART 3 - EXECUTION**

### **3.01 PROJECT CONDITIONS**

- A. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during TAB operations to minimize conflicts with the Owner's operations.

### **3.02 EXAMINATION**

- A. Examine Contract Documents to become familiar with project requirements and existing building record documents (if available) to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
  - 1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
  - 2. Verify that balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of Plumbing systems and equipment.
- C. Examine equipment performance data including pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- D. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- E. Examine system and equipment installations to verify that indicated balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- F. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- G. Examine open-piping-system pumps to ensure absence of entrained air in the suction piping.
- H. Examine equipment for installation and for properly operating safety interlocks and controls.

- I. Examine automatic temperature system components to verify the following:
  - 1. Valves, and other controlled devices operate by the intended controller.
  - 2. Valves are in the position indicated by the controller.
  - 3. Integrity of valves for free and full operation and for tightness of fully closed and fully open positions.
  - 4. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.
  - 5. Sensors are located to sense only the intended conditions.
  - 6. Sequence of operation for control modes is according to the Contract Documents.
  - 7. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
- J. Report deficiencies discovered before and during performance of TAB procedures.
- K. Beginning of work means acceptance of existing conditions.

### **3.03 PREPARATION**

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
  - 1. Permanent electrical power wiring is complete.
  - 2. Systems are filled, clean, and free of air.
  - 3. Automatic temperature-control systems are operational.
  - 4. Isolating and balancing valves are open and control valves are operational.
- C. Hold a pre-balancing meeting at least one week prior to starting TAB work.
  - 1. Attendance is required by installers whose work will be tested, adjusted, or balanced.
- D. Provide instruments required for TAB operations. Make instruments available to Architect to facilitate spot checks during testing.

### **3.04 GENERAL TESTING AND BALANCING PROCEDURES**

- A. Perform TAB procedures on each system according to the procedures contained in AABC national standards or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
- B. Cut insulation for pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
- C. Mark equipment settings with paint or other suitable, permanent identification material, including control positions, valve indicators and similar controls and devices, to show final settings.

### **3.05 ADJUSTMENT TOLERANCES**

- A. Piping Systems: Adjust to within plus or minus 10 percent of design.

### **3.06 RECORDING AND ADJUSTING**

- A. Field Logs: Maintain written logs including:
  - 1. Running log of events and issues.
  - 2. Discrepancies, deficient or uncompleted work by others.
  - 3. Contract interpretation requests.
  - 4. Lists of completed tests.
- B. Ensure recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves and other adjustment devices allowing settings to be restored. Set and lock memory stops.

- D. Mark on drawings locations where other critical measurements were taken and cross reference location in final report.

### **3.07 FUNDAMENTAL PROCEDURES FOR PIPING SYSTEMS**

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 10 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare systems for TAB according to the following, in addition to the general preparation procedures specified above:
  - 1. Open manual valves for maximum flow.
  - 2. Check expansion tank liquid level, or air charge if bladder type.
  - 3. Check makeup-water-station pressure gauge for adequate pressure.
  - 4. Check flow-control valves for specified sequence of operation and set at design flow.
  - 5. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

### **3.08 FINAL REPORT**

- A. General: Computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into Sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified TAB engineer.
  - 1. Include a list of the instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to the certified field report data, include the following:
  - 1. Pump curves.
  - 2. Field test reports prepared by system and equipment installers.
  - 3. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.
- D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
  - 1. Title page.
  - 2. Name and address of TAB Agent.
  - 3. Project name.
  - 4. Project location.
  - 5. Architect's name and address.
  - 6. Engineer's name and address.
  - 7. Contractor's name and address.
  - 8. Report date.
  - 9. Signature of TAB Agent who certifies the report.
  - 10. Summary of contents, including the following:
    - a. Design versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  - 11. Nomenclature sheets for each item of equipment.
  - 12. Notes to explain why certain final data in the body of reports vary from design values.
- E. Pump Test Reports: For pumps, include the following data. Calculate impeller size by plotting the shutoff head on pump curves.
  - 1. Unit Data: Include the following:
    - a. Unit identification.
    - b. Location.
    - c. Service.
    - d. Make and size.



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- e. Model and serial numbers.
- f. Water flow rate in gpm (L/s).
- g. Water pressure differential in feet of head or PSIG (kPa).
- h. Required net positive suction head in feet of head or PSIG (kPa).
- i. Pump rpm.
- j. Impeller diameter in inches.
- k. Motor make and frame size.
- l. Motor horsepower and rpm.
- m. Voltage at each connection.

**END OF SECTION**

**SECTION 220700  
PLUMBING INSULATION**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Type 1, Glass Wool Pipe Insulation
  - 2. Type 2, Flexible Elastomeric Insulation
  - 3. Type 5, Glass Wool Equipment Insulation
  - 4. Type 7, ADA Accessible Lavatory/Sink Insulation Kit
  - 5. Accessories
  - 6. Pipe Fitting Insulation Covers

**1.02 RELATED SECTIONS**

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Piping insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Installer qualifications.
  - 2. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
  - 3. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets with requirements indicated. Include dates of tests.
  - 4. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.
  - 5. Submit manufacturer's installation instructions.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements apply to this Section.
- B. In addition, meet the following:
  - 1. Formaldehyde Free: Should be third-party certified with UL Environment Validation.
  - 2. Recycled Content: A minimum of 40 percent post-consumer recycled glass content certified and UL validated.
  - 3. Low Emitting Materials: For all thermal and acoustical applications of Glass Mineral Wool Insulation products, provide materials complying with the testing and products requirements of UL GREENGUARD Gold Certification.
  - 4. Installer to have minimum 5 years' experience in the business of installing insulation.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

### 1.07 FIRE HAZARD CLASSIFICATION

- A. Maximum fire hazard classification of the composite insulation construction as installed to be not more than a Flame Spread Index (FSI) of 25 and Smoke Developed Index (SDI) of 50 as tested by current edition of ASTM E84 (NFPA 255) method.
- B. Test pipe insulation in accordance with requirements of current edition of UL "Pipe and Equipment Coverings".

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Type 1, Glass Wool Pipe Insulation:
  - 1. Owens-Corning
  - 2. Johns Manville
  - 3. Or approved equivalent.
- B. Type 2, Flexible Elastomeric Insulation:
  - 1. Insulation:
    - a. Armacell LLC Armaflex
    - b. K-Flex
    - c. Or approved equivalent.
  - 2. Glue:
    - a. Armacell LLC Armaflex Low VOC Adhesive
    - b. K-Flex
    - c. Or approved equivalent.
  - 3. Paint:
    - a. Armacell LLC Armaflex
    - b. K-Flex
    - c. Or approved equivalent.
- C. Type 5, Glass Wool Equipment Insulation:
  - 1. Knauf
  - 2. Owens-Corning
  - 3. Johns Manville
  - 4. Or approved equivalent.
- D. Type 7, ADA Accessible Lavatory/Sink Insulation Kit:
  - 1. IPS/Truebro
  - 2. McGuire/Pro-Wrap
  - 3. Plumberex/Pro-Extreme
  - 4. Brocar Trap Wrap
  - 5. Or approved equivalent.
- E. Accessories:
  - 1. ITW Insulation Systems
  - 2. Or approved equivalent.
- F. Pipe Fitting Insulation Covers:
  - 1. Zeston Johns Manville
  - 2. ITW Insulation Systems
  - 3. Or approved equivalent.

### 2.02 TYPE 1, GLASS WOOL PIPE INSULATION

- A. Glass Fiber: ASTM C547 Type I and IV; rigid molded, noncombustible.
  - 1. Thermal Conductivity Value: 0.27 BTU\*in/(hr\*sF) at 75 degrees F.
  - 2. Maximum Service Temperature: 850 degrees F to 1000 degrees F.

3. Vapor Retarder Jacket: White Kraft paper reinforced with glass fiber and bonded to aluminum foil, with self-sealing longitudinal laps and butt strips or vapor barrier mastic.

### **2.03 TYPE 2, FLEXIBLE ELASTOMERIC INSULATION**

- A. Elastomeric Foam: ASTM C534; flexible, cellular elastomeric, molded or sheet.
  1. Thermal Conductivity Value: 0.25 BTU\*in/(hr\*sf\*F) at 75 degrees F.
  2. Maximum Service Temperature of 220 degrees F.
  3. Maximum Flame Spread: 25.
  4. Maximum Smoke Developed: 50 (3/4-inch thick and below).
  5. Connection: Waterproof vapor retarder adhesive as needed.
  6. UV Protection: UV outdoor protective coating per manufacturer's requirements.
- B. Glue: Contact adhesive specifically manufactured for cementing flexible elastomeric foam.
- C. Paint: Nonhardening high elasticity type, specifically manufactured as a protective covering of flexible elastomeric foam insulation for prevention of degradation due to exposure to sunlight and weather.

### **2.04 TYPE 5, GLASS WOOL EQUIPMENT INSULATION**

- A. Flexible Glass Wool Blanket: ASTM C612; flexible.
  1. Thermal Conductivity Value: 0.24 BTU\*in/(hr\*sf\*F) at 75 degrees F.
  2. Maximum Service Temperature: 450 degrees F.

### **2.05 TYPE 7, ADA ACCESSIBLE LAVATORY/SINK INSULATION KIT**

- A. P-traps, trap arms, tail pieces, hot water and cold water insulating guards meeting ASTM C1822. Molded closed cell insulation with vinyl cover and nylon fasteners, paintable. Provide accessories as required for complete installation covering all exposed waste piping, water piping, stops and supplies. Color white.

### **2.06 ACCESSORIES**

- A. Equipment Insulation Compounds: Provide adhesives, cement, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.
- B. Provide staples, bands, wire, wire netting, tape corner angles, anchors, stud pins and metal covers as recommended by insulation manufacturer for applications indicated. Accessories, i.e., adhesives, mastics, cements and tape to have same flame and smoke component ratings as insulation materials with which they are used. Shipping cartons to bear a label indicating that flame and smoke ratings do not exceed those listed above. Provide permanent treatment of jackets or facings to impart flame and smoke safety. Provide non-water soluble treatments. Provide UV protection recommended by manufacturer for outdoor installation.

### **2.07 PIPE FITTING INSULATION COVERS**

- A. PVC Plastic Fitting Covers: Schuller Zeston 2000, Knauf Proto Fitting or approved equivalent. One-piece molded type fitting covers and jacketing material, gloss white. Connections: Tacks; pressure sensitive color matching vinyl tape.

## **PART 3 - EXECUTION**

### **3.01 GENERAL INSTALLATION INFORMATION**

- A. Verification of Conditions:
  1. Do not apply insulation until pressure testing and inspection of piping has been completed.
  2. Examine areas and conditions under which insulation will be installed. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Preparation: Clean and dry surfaces to be insulated.
- C. Installation:
  1. Insulation: Continuous through walls, floors and partitions except where noted otherwise.
  2. Piping and Equipment:

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- a. Install insulation over clean, dry surfaces with adjoining sections firmly butted together and covering surfaces. Fill voids and holes. Seal raw edges. Install insulation in a manner such that insulation may be split, removed, and reinstalled with vapor barrier tape on strainer caps and unions. Do not install insulation until piping has been leak tested and has passed such tests. Do not insulate manholes, equipment manufacturer's nameplates, handholes, and ASME stamps. Provide beveled edge at such insulation interruptions. Repair voids or tears.
- D. Provide accessories as required. See Part 2 Article "Accessories" above.
- E. Protection and Replacement: Protect installed insulation during construction. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- F. Labeling and Marking: Provide labels, arrows and color coding on piping. Attach labels and flow direction arrows to jacketing per Section 22 05 53, Identification for Plumbing Piping and Equipment.
- G. Insulation Shields: Provide hangers and shields (18 gauge minimum) outside of insulation for cold piping (<60 degrees F). Hot water piping hangers may penetrate insulation to contact pipe directly. Provide 18-inch long, noncompressible insulation section at insulation shields for lines 1-1/2-inches and larger (hot and cold piping).
- H. Piping Surfaces to be Insulated:

Item to be Insulated	System Insulation Type	Pipe Size	Insulation Thickness
Hot Water Piping Above Grade (105F to 140F)	1	Runouts =<1-1/4-inch (uncirculated branches located in partitions within conditioned spaces)	1-inch
		Mains =<1-1/4-inch	1-inch
		Mains >1-1/4-inch	1-1/2-inch
Hot Water Circulation Piping Above Grade (105F to 140F)	1	Mains =<1-1/4-inch	1-inch
		Mains >1-1/4-inch	1-1/2-inch
Cold Water Piping Above Grade	1	=<1-1/2-inch	1/2-inch
		>1-1/2-inch	1-inch
Above Grade Roof Drain/Overflow Drain Piping	1, 2	All	1/2-inch
Roof Drain Underbodies	5, 6	N/A	1-inch
Overflow Roof Drain Underbodies	5, 6	N/A	1-inch
ADA Accessible Lavatory/Sink	7	All	As Listed
Condensate Drain Piping	1, 2	All	1/2-inch

**3.02 TYPE 1, GLASS WOOL PIPE INSULATION**

- A. See General Installation Requirements above.

- B. Install in accordance with manufacturer's instructions for below grade installation.
- C. Lap seal insulation with waterproof adhesive. Do not use staples or other methods of attachment which would penetrate vapor barrier. Apply fitting covers with seated tacks and vapor barrier tape.
- D. Apply insulation to pipe and seal with self-sealing lap. Use self-sealing butt strips to seal butt joints. Insulate fittings, valves and unions with single or multiple layers of insulation and cover to match pipe or use preformed PVC molded insulation covers.
- E. Above Grade Roof Drain/Overflow Drain Piping: Cover all roof drain piping and overflow drain piping with sectional pipe covering.

**3.03 TYPE 2, FLEXIBLE ELASTOMERIC INSULATION**

- A. See General Installation Requirements above.
- B. Install in accordance with manufacturer's instructions for below grade installation.
- C. Slip insulation on pipe prior to connection. Butt joints sealed with manufacturer's adhesive. Insulate fitting with miter-cut pieces. Cover insulation exposed to weather and undergrade with two coats of finish as recommended by manufacturer.
- D. Above Grade Roof Drain/Overflow Drain Piping: Cover all roof drain piping and overflow drain piping with sectional pipe covering.
- E. Flexible Elastomeric Tubing: Slip insulation over piping or if piping is already installed, it should be slit and snapped over piping. Joints and butt ends must be adhered with 520 adhesive.

**3.04 TYPE 5, GLASS WOOL EQUIPMENT INSULATION**

- A. See General Installation Requirements above.
- B. Apply insulation and accessories to roof drain underbodies per manufacturer's recommendations.
- C. Roof Drain/Overflow Drain Underbodies: Cover underside of drain body with glass wool insulation; attached with adhesive and supported externally with 26 gauge galvanized flat strapping anchored to structure.
- D. Storage Tanks: Cover with glass wool, 2-inches thick. Finish with canvas jacket and adhesive. Overlap joints minimum of 4-inches. Apply two coats latex paint; color selected by Architect.

**3.05 TYPE 7, ADA ACCESSIBLE LAVATORY/SINK INSULATION KIT**

- A. See General Installation Requirements above.
- B. Install in accordance with manufacturer's instructions.
- C. Provide lavatory/sink insulation kit. Install on waste fittings, hot and cold water stops and supplies.

**3.06 ACCESSORIES**

- A. See General Installation Requirements above.
- B. Install in accordance with manufacturer's instructions.
- C. Furnish and install accessories for all insulation types listed in this Section.

**3.07 PIPE FITTING INSULATION COVERS**

- A. See General Installation Requirements above.
- B. Install in accordance with manufacturer's instructions.

**END OF SECTION**

**SECTION 220800  
COMMISSIONING OF PLUMBING**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. Section includes Commissioning activities required for work of Division 22 Sections including but not limited to construction checks, equipment start-up, functional testing, and operator training.
- B. Comply with Section 01 91 13 – General Commissioning Requirements for Commissioning activities for Division 22 work.

**1.02 SEQUENCING**

- A. Provide written notification to Commissioning Provider (CxP) in advance of significant project dates as directed and as listed below.
  - 1. Two weeks prior to start-up of hot water heaters
  - 2. Four weeks prior to installation of lay-in ceiling tiles or other partial concealment of equipment to be commissioned
  - 3. Four weeks prior to any system being ready for balancing

**1.03 SUBMITTALS**

- A. Provide submittals of systems being commissioned to Owner's Authorized Representative as required by Section 01 91 13.

**PART 2 - PRODUCTS**

**2.01 NOT USED**

**PART 3 - EXECUTION**

**3.01 CONSTRUCTION CHECKLISTS**

- A. Contractor shall execute as required by Section 01 91 13. Construction Checklists for each system being commissioned will be prepared by the CxP during construction.

**3.02 FUNCTIONAL TESTING**

- A. Contractor shall assist CxP with functional testing as required by Section 01 91 13. Functional Test Plans for each system being commissioned will be prepared by CxP during construction and will generally include a rigorous verification of instrument calibration, equipment performance, package equipment control system operations, automatic control sequence of operations, fire and life safety sequences, and operator interface functions. CxP will supervise and document functional testing. Contractor shall provide qualified technicians to assist CxP during on-site testing and perform the following functions.
  - 1. Operate equipment and systems as necessary to conduct testing.
  - 2. Manipulate control parameters to simulate test conditions as detailed in Functional Test Plans.
  - 3. Provide proprietary hardware and software as needed to interface with manufacturers packaged control systems.
- B. Labor required for retesting due to failure of equipment, or systems not performing in accordance with Contract Documents shall be provided at no additional cost to Owner.

**3.03 OPERATIONS AND MAINTENANCE TRAINING**

- A. The Contractor shall provide operation and maintenance instruction to Owner's personnel as required by Division 01 and 22.

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**3.04 SCHEDULE OF SYSTEM BEING COMMISSIONED**

- A. Commission systems and equipment listed below including associated equipment, piping, and control systems.
- B. Plumbing Systems:
  - 1. Domestic water heaters
  - 2. Plumbing pumps

**END OF SECTION**



**SECTION 221000  
PLUMBING PIPING**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Sanitary, Drainage (Rain/Stormwater) DWV Piping, Buried Within 5-feet of Building
  - 2. Sanitary, Drainage (Rain/Stormwater) DWV Piping, Above Grade
  - 3. Pump Waste Pressure Piping (Pumped Discharge)
  - 4. Water Piping, Buried Within 5-feet of Building
  - 5. Hot and Cold Domestic Water Above Grade
  - 6. Condensate Piping
  - 7. Primer Piping
  - 8. Piping Specialties
  - 9. Cleanouts

**1.02 RELATED SECTIONS**

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. NSF 61, Annex G.
  - 2. Steel pipe to conform to ASTM and ANSI Standards as specified in this Section.
  - 3. Copper piping to conform to ASTM B88, B306 and B208 and the standards of Copper Development Association (CDA), and American Welding Society, (AWS).
  - 4. Cast Iron Piping to conform to standards of ASTM A-74, CISPI 301 and FM 1680.
  - 5. Manufacturer's Standards Society (MSS) for valving and support reference standard.
  - 6. American Water Works Association (AWWA) for Valving Assembly Standards.
  - 7. American Society of Sanitation Engineers (ASSE) for Valving Standards.
  - 8. American National Standards Institute (ANSI) for Piping Standards.
  - 9. NFPA Standard 51B - "Fire Prevention in Use of Cutting and Welding Processes".
  - 10. Crosslinked polyethylene (PEX) pipe conforming to ASTM F876, F877 and CSA B1375, or DIN 16892 and 16893.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

- A. See component manufacturers listed in individual articles below.
- B. ADS
- C. American-USA

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- D. Cerro
- E. Charlotte
- F. Clamp-All
- G. Conbraco/Apollo Press
- H. Elkhart
- I. Enfield
- J. Fusesseal
- K. Gruvlok
- L. Husky
- M. Ideal
- N. Mifab
- O. Mission
- P. Mueller
- Q. Nibco
- R. Orion
- S. Shurjoint Mechanical Couplings
- T. Sioux Chief
- U. Spears
- V. Tyler
- W. Uponor
- X. Viega
- Y. Zurn
- Z. Or approved equivalent.
- AA. Cleanouts:
  - 1. J.R. Smith
  - 2. Mifab
  - 3. Sioux Chief
  - 4. Wade
  - 5. Watts
  - 6. Zurn
  - 7. Or approved equivalent.
- BB. Firestopping Penetrations in Fire Rated Wall Floor Assemblies:
  - 1. Hilti
  - 2. Proset
  - 3. Or approved equivalent.

**2.02 GENERAL**

- A. Provide pipe, tube and fittings of the same type, fitting requirements, grade, class and the size and weight indicated or required for each service, as indicated in other Division 22, Plumbing Specifications. Where type, grade, or class is not indicated, provide proper selection as determined by installer for installation requirements, and comply with governing regulations and industry standards.
- B. Manufactured materials delivered, new to the project site and stored in their original containers.

- C. Product Marking: Furnish each item with legible markings indicating name brand and manufacturer, manufacturing process, heat number and markings as required per ASTM and UL/FM Standards.

**2.03 SANITARY, DRAINAGE (RAIN/STORMWATER) DWV PIPING, BURIED WITHIN 5-FEET OF BUILDING**

- A. PVC Pipe: ASTM D 2665 IPS Schedule 40, **SOLID WALL** piping for drainage/waste and vent (DWV).
  - 1. Fittings: PVC DWV ASTM D2665.
  - 2. Joints: Solvent welded, with ASTM D2564 solvent cement, 2-step glue (primer and glue) is required.

**2.04 SANITARY, DRAINAGE (RAIN/STORMWATER) DWV PIPING, ABOVE GRADE**

- A. Cast Iron Pipe (Rain/Stormwater): ASTM A888/CISPI 301 hubless.
  - 1. Fittings: Cast iron.
  - 2. Coupling Assembly:
    - a. Standard Duty: ASTM C1277 or CISPI 310.
- B. PVC Pipe (Sanitary): ASTM D 2665 IPS Schedule 40, **SOLID WALL** piping for drainage/waste and vent (DWV).
  - 1. Fittings: PVC DWV ASTM D2665.
  - 2. Joints: Solvent welded, with ASTM D2564 solvent cement, 2-step glue (clear primer and glue) is required.

**2.05 PUMP WASTE PRESSURE PIPING (PUMPED DISCHARGE)**

- A. PVC Pipe: ASTM D1785 Schedule 80, pressure pipe for not less than 150 PSI pressure rating.
  - 1. Fittings: ASTM D 2466, PVC.
  - 2. Joints: Solvent welded, with ASTM D 2564.

**2.06 WATER PIPING, BURIED WITHIN 5-FEET OF BUILDING**

- A. PVC Pipe: ASTM D1785 Schedule 80, pressure pipe for not less than 150 PSI pressure rating.
  - 1. Fittings: ASTM D 2466, PVC.
  - 2. Joints: Solvent welded, with ASTM D 2564.

**2.07 HOT AND COLD DOMESTIC WATER ABOVE GRADE**

- A. Copper Tube: 3-inches and above. ASTM B88 (ASTM BA88m), Type K (A), Drawn.
  - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
  - 2. Joints: Brazed BCuP2.
- B. Copper Tube: 2-1/2-inches and smaller. ASTM B88 (ASTM B88M), Type L (B), Drawn.
  - 1. Fittings: ASME B16.18 copper.
  - 2. Joints: ASTM B32, alloy Sn95 solder.
- C. Stainless Tube:
  - 1. Piping 3-inch and Larger: Grade H, ASTM A268/A268M-91, roll-grooved joint.
  - 2. Fittings: Schedule 10S Type 304L stainless steel fittings, ISO 9001, ASTM A-403.
  - 3. Couplings: Anvil or Gruvlok grooved system, IPS stainless steel grooved coupling with EPDM gasket, stainless steel nuts and bolts, ASTM-A351, A743 AND A744-CF-8M, ISO 9001.
- D. Copper Tube: ASTM B88 (ASTM B88M), Type L (B) for 2-1/2-inches and smaller, Type K (A) for 3-inches and larger, Drawn.
  - 1. Fittings: Fittings are to be manufactured to copper tubing sizes, with grooves designed to accept grooved end couplings of the same manufacturer. Fittings are to be wrought copper, conforming to ASTM B75 alloy C12200 or ASTM B-152 alloy C11000 and ANSI B16.22.

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2. Coupling: 2-inches to 8-inches for copper tubing consisting of ductile iron cast housings meeting ASTM A536, complete with a synthetic rubber gasket of a pressure-responsive design, with plated nuts and bolts to secure unit together. Couplings to be manufactured to connect copper tubing sized tube and fittings.
- E. Cross-Linked Polyethylene Tubing - Type "A" - Engle Method - Fittings and Accessories (except exposed locations).
  1. Tubing:
    - a. Cross-linked polyethylene (PEX) tubing complies with requirements of ASTM F876 and F877, and cross-linking method must be Type A (hot)method.
    - b. PEX tubing to have minimum working pressure of not less than 160 PSI for water at 73.4 degrees F, 100 PSI for water at 180 degrees F and 80 PSI for water at 200 degrees F determined in accordance with Plastic Pipe Institute Technical Report TR-3/92, and listed in Plastic Pipe Institute Technical Report TR-4/95.
    - c. Co-extruded – “colored piping” (blue/red) is not to be utilized.
  2. Fittings:
    - a. Fittings: Engineered Plastic Fittings for above grade applications. Engineered plastic fittings for below grade applications. Serrated type with reinforcement rings.
    - b. Reinforcement Rings: Manufactured using "Engel Method" to ensure that viscoelastic stress regenerative properties are sufficient to produce pressure tight seal.
    - c. Fitting Insert: Of such dimension in that tubing must be expanded in order to facilitate insertion of fitting into tube.
    - d. Accomplish expansion of tubing and ring by an expansion tool designed expressly for that purpose.
    - e. Fittings complies with requirements of ASTM F877.
  3. Manifolds: Provide premanufactured copper manifolds of same manufacturer as piping.
  4. Stub-out Ells and Stub-out Brackets: Provide premanufactured Type L copper stub-out ells and copper stub-out brackets.
- F. Mechanical Press Fittings (1/2-Inch Through 2-Inch):
  1. Mechanical press-connect fittings made out of bronze or copper conforming to the performance requirements of IAPMO PS117, ANSI/ICC LC1002, ASME B16.51and NSF 61-G. Fittings with EPDM sealing element and leak detection feature that identifies un-pressed fittings during testing (Smart Connect).

## 2.08 CONDENSATE PIPING

- A. Copper Tube: ASTM B 88 (ASTM B898M), Type K (A), L (B), or M (C).
  1. Fittings: ASME B16.29, wrought copper.
  2. Joints: ASTM B32, alloy Sn50 solder.
- B. Use chemical resistant piping for drainage of condensate from combustion fuel sources (such as condensing boilers and water heaters), as noted in this Section for area of application.
- C. CPVC (Chlorinated Polyvinyl Chloride) Pipe and Fittings - Except Exterior of the Building and in Plenums and Rated Assemblies:
  1. Pipe and Fittings: Schedule 40, NSF-14, ASTM 439, IAPMO IS20-96, socket fittings, solvent weld.

## 2.09 PRIMER PIPING

- A. Above Ground: Type L hard-drawn copper tubing with wrought sweat fittings and soldered joints.
- B. Below Ground: Type L soft annealed copper tubing with wrought sweat fittings and brazed joints.
- C. Below Ground: Cross-linked polyethylene (PEX) and engineered plastic fittings.

## 2.10 PIPING SPECIALTIES

- A. Pipe Escutcheons:
1. Provide pipe escutcheons as specified with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime zinc base paint finish for unoccupied areas.
  2. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide stainless steel, cast brass or sheet brass escutcheons, solid or split hinged.
  3. Pipe Escutcheons for Dry Areas: Provide stainless steel escutcheons, solid or split hinged.
- B. Low Pressure Y-Type Pipeline Strainers:
1. Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 125 percent of the working pressure of piping system with Type 304 stainless steel screens made with 1/16-inch perforations on 4-inch and smaller strainers, and 1/8-inch perforations on 6-inch and larger strainers.
  2. Threaded Ends, 2-inch and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with plus.
  3. Flanged Ends, 2-1/2-inch and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with hose bibb.
- C. Air Vent with Valves:
1. Install automatic air vents in all closed and open-loop water systems at high points and at any other point necessary to free system of air. Provide shut-off valve in riser to each automatic vent valve to facilitate servicing. Manual type vent may be used in lieu of automatic type, where specifically shown on the Drawings.
  2. Manufacturer: Hoffman #79.
- D. Dielectric Waterways:
1. Provide standard products recommended by manufacturers in service indicated, which effectively isolate ferrous from non-ferrous piping (eliminating electrical conductance) to prevent galvanic action and stop corrosion.
  2. Provide dielectric waterways or brass nipple fitting for transitions between dissimilar metal piping.
- E. Unions:
1. Unions to comply with the following schedule:
    - a. Black Steel, 2-inch and smaller: 150 PSI screwed malleable iron, ground joint, brass to iron seat.
    - b. Black Steel, 2-1/2-inch and larger: 150 PSI cast iron screwed flanged, flat faced, full faced gasket.
    - c. Soldered Copper or Brass Pipe, 2-inch and smaller: 150 PSI cast bronzed or copper, ground joint, non-ferrous seat with soldered ends.
    - d. Screwed Copper or Brass Pipe, 2-inch and smaller: 150 PSI cast brass, ground joint, brass to brass seat, threaded ends.
    - e. Flanged Copper or Brass Pipe, 2-1/2-inch and larger: Two 150 PSI cast bronze flanges.
    - f. Manufacturer: EPCO, Mueller, Stanley G. Flagg, Watts, or approved equivalent.
- F. Flexible Piping Connectors - Expansion Loops or Seismic Joints:
1. Provide flexible expansion loops of size and material noted on Drawings. Design flexible loops to impart no thrust loads on the anchors. The loop consists of two flexible sections of hose and braid, two 90 degree elbows, and a 180 degree return. Install loops in a neutral, precompressed, or pre-extended condition as required for the application. Provide drain plug for loops installed hanging down. Loops installed straight up may be fitted with

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an automatic air release valve to purge air from the high point of the loop. Loops installed in any position other than hanging down must have the 180 degree return supported.

2. Copper Pipe: Copper fittings, bronze hose and braid sweat solder ends, Metraloop Series MLS 8000.
3. Steel Pipe: Schedule 40 carbon steel fittings, stainless steel hose and braid,
4. Threaded Ends: Metraloop Series MLT 80000
5. Flanged Ends: Metraloop Series MLF 80000
6. Welded Ends: Metraloop Series MLW 80000
7. Grooved Ends: Metraloop Series MLG 80000
8. Gas Lines, CSA Approved: Metraloop - Gas MLT or MLF Series.
9. Provide expansion joints by Mason, Flexionics, or Shur Fit, for vertical and horizontal straight run hot water and domestic hot water recirculation piping exceeding 1,000-feet. Install per manufacturer's installation directions.

## 2.11 CLEANOUTS

- A. Locate cleanouts as shown on Drawings and as required by local code. Cleanouts same size as pipe except that greater than 4-inches will not be required. Plastic components not allowed, except unless specifically noted.
- B. Types:
  1. Tile Floor Cleanouts: J. R. Smith 4020 with round heavy-duty nickel bronze top, taper thread, ABS plug and standard screws.
  2. Carpeted Floor Cleanout: J. R. Smith 4020-X with carpet clamping frame, round heavy-duty nickel bronze top, taper thread, ABS plug, carpet clamping device and standard screws.
  3. Concrete Floor Cleanout (General): J. R. Smith 4020 with round heavy-duty nickel bronze top, taper thread and ABS plug with standard screws.
  4. Parking, Drives and Concrete Floor Cleanouts (Heavy Load): J. R. Smith 4100 with round heavy-duty nickel bronze top, taper thread and ABS plug with standard screws.
  5. Wall Cleanout: J. R. Smith 4472-U, countersunk bronze taper thread plug, stainless steel shallow cover and vandalproof screws.
  6. Outside Area Walks: J. R. Smith 4020-U with round heavy-duty nickel bronze top, taper thread, ABS plug and top secured with vandalproof screws. Install in 18- by 18- by 6-inch deep concrete pad flush with grade.

## PART 3 - EXECUTION

### 3.01 GENERAL INSTALLATION REQUIREMENTS

- A. Underground Piping Systems:
  1. Examination: Verify that excavations are to required grade, dry, and not over-excavated.
  2. Perform necessary excavation and backfill required for installation of plumbing work. Repair piping or other work at no expense to Owner.
  3. Water: Keep excavations free of standing water. Re-excavate and fill back excavations damaged or softened by water or frost to original level with sand, crushed rock or other approved material at no expense to Owner.
  4. Tests: During progress of work for compacted fill, Owner reserves right to request compaction tests made under direction of testing laboratory.
  5. Trench Excavation: Excavate trenches to necessary depth and width, removing rocks, unstable soil (muck, peat), roots and stumps. Excavation material is classified as "base fill" and "native." Base fill excavation material consisting of placed crushed rock may be used as backfill above "Pipe Zone." Remove and dispose off site native excavation material. Adequate width of trench for proper installation of piping or conduit.
  6. Support Foundations:
    - a. Foundations: Excavate trenches located in unstable ground areas below elevation required for installation of piping to depth which is determined by Architect as

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appropriate for conditions encountered. Place and compact approved foundation material in excavation up to "Bedding Zone." Dewatering, placement, compaction and disposal of excavated materials to conform to requirements contained in other Specification Sections or Drawings.

- b. Over-Excavations: Where trench excavation exceeds required depths, provide, place and compact suitable bedding material to proper grade or elevation at no additional cost to Owner.
- c. Foundation Material: Where native material has been removed, place and compact necessary foundation material to form base for replacement of required thickness of bedding material.

	Class A		Class B	
Material Passing	Min.	Max.	Min.	Max.
3/4-inch Square Opening	27	47	0	1

- d. Bedding Material: Full bed piping on sand, pea gravel, or 3/4-inch minus crushed rock. Place minimum 4-inch deep layer of sand, pea gravel, or crushed rock on leveled trench bottom for this purpose. Remove bedding to necessary depth for piping bells and couplings to maintain contact of pipe on bedding for its entire length. Provide additional bedding in excessively wet, unstable, or solid rock trench bottom conditions as required to provide firm foundation.

7. Backfilling:

- a. Following installation and successful completion of required tests, backfill piping in lifts.
  - 1) In "Pipe Zone" place backfill material and compact in lifts not to exceed 6-inches in depth to height of 12-inches above top of pipe. Place backfill material to obtain contact with entire periphery of pipe, without disturbing or displacing pipe.
  - 2) Place and compact backfill above "Pipe Zone" in layers not to exceed 12-inches in depth.
- b. Backfill Material:
  - 1) Backfill Material in "Pipe Zone": 3/4-inch minus crushed rock, sand or pea gravel.
  - 2) Crushed rock, fill sand or other backfill material approved elsewhere in Specifications may be used above "Pipe Zone."

8. Compaction of Trench Backfill:

- a. Where compaction of trench backfill material is required, use one of following methods or combination thereof:
  - 1) Mechanical tamper,
  - 2) Vibratory compactor, or
  - 3) Other approved methods appropriate to conditions encountered.
- b. Architect to have right to change methods and limits to better accommodate field conditions. Compaction sufficient to attain 95 percent of maximum density at optimum moisture content unless noted otherwise on Drawings or elsewhere in Specifications. Water "puddling" or "washing" is prohibited.

B. General Installation:

- 1. Work performed by experienced journeyman plumbers. No exceptions.
- 2. Provide access panels for concealed valves, shock arrestors, trap primers and the like.
- 3. Install pipes and pipe fittings in accordance with recognized industry practices and manufacturer's recommendations.
- 4. Align piping accurately at connections, within 3/32-inch misalignment tolerance. Comply with ANSI B31 Code for Pressure Piping.

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5. Locate piping runs, as indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details, and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, and other structural and permanent-enclosure elements of building. Limit clearance to 1/2-inch where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1-inch clearance outside insulation. Whenever possible in finished and occupied spaces, conceal piping from view by locating it in column enclosures, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as indicated.
    - a. Do not run piping through transformer vaults, telephone, elevator, electrical or electronic equipment spaces or enclosures unless indicated on Drawings.
    - b. Concealed Piping Above Suspended Ceiling: Plan and coordinate to avoid interferences; install to maintain suspended ceiling heights shown on Architectural Drawings. Allow sufficient space above removable ceiling panels for panel removal. Locate piping so that valves are visible and accessible within 24-inches horizontally and vertically from point of access to the ceiling space. Provide plenum rated materials for ceiling spaces which are being used as plenums.
    - c. Exposed Work: Run pipes parallel to the closest wall unless otherwise shown on Drawings; maintain maximum headroom; avoid light fixtures.
    - d. Insulation Space Allowance: In piping work, allow space for pipe insulation and jackets. If interferences occur, move the piping to accommodate insulation thickness specified.
    - e. Pipe Lengths: Do not use short lengths or nipples at locations where a full length of pipe will fit.
    - f. Alignment Prior to Supporting and Anchoring: Place piping in proper alignment and position prior to connection to anchors, expansion loops, and equipment. Furnish jacking devices, temporary steel structural members, and assembled structures as necessary. Remove temporary equipment and structures supplied by contractor at completion; such items to remain Contractor property.
    - g. Valve and Equipment Connections: Piping not to place undue stress on flanged valves and equipment connections. Install mating flange faces true and parallel to each other and not requiring springing of piping for assembly. Pipe hangers and supports to carry the full weight of the pipe and fluid.
    - h. Piping Leaks: Correct immediately; use new materials; leak-sealing compounds or peening not permitted.
    - i. Pressure Ratings of Fittings, Valves, and Devices in Piping Systems: Pressure rating to be equal to, or greater than, the maximum working pressure of the system.
    - j. Equipment Vents and Drains: Provide for coils and vessels which contain water. Provide isolation valves and outlet valves at piping high and low points to permit venting and draining of the vessel without venting and draining connected piping. Provide hose connections and caps on drain lines.
    - k. Escutcheon Plates: Where exposed insulated and uninsulated piping passes through walls, floors or ceilings; provide spring clip type. Provide plates on both sides of wall or floor.
- C. Testing:
1. General:
    - a. Provide temporary equipment for testing, including pumps, compressors, tanks, and gauges, as required. Test piping systems before insulation (if any) is installed and remove or disengage control devices before testing. Where necessary, test sections of each piping system independently, but do not use piping valves to isolate sections where test pressures exceed local valve operating pressure rating. Fill each section with water, compressed air, or nitrogen and pressurize for the indicated pressure and



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- time.
  - b. Notify Architect and local Plumbing Inspector 2 days before tests.
  - c. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.
  - d. Water Piping: Eliminate air from system. Fill and test at 125 PSIG or minimum 1-1/2 times static pressure at connection to serving utility main for period of two hours with no loss in pressure.
  - e. Send test results to Architect for review and approval and include in Operation and Maintenance Manual.
2. Testing of Pressurized Systems:
- a. Test each pressurized piping system at 150 percent of operating pressure indicated, but not less than 125 PSIG test pressure.
  - b. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 2 percent of test pressure.
3. Test hot and cold domestic water piping systems upon completion of rough-in and before connection to fixtures at hydrostatic pressure of 125 PSIG.
- D. Corrosive Soil Conditions:
- 1. Wrap steel, iron, copper or other metal piping materials/fittings with Protecto Wrap 200, 30 mils or greater. Maintain a 1/2-inch overlap and install per manufacturer's recommendations.
  - 2. Provide epoxy coated cast iron pipe and fittings for drainage systems.
  - 3. Obtain and review project soils report for verification of requirements concerning corrosive soils.
- E. Protection:
- 1. Keep pipe openings closed by means of plugs or caps to prevent entrance of foreign matter. Protect piping, ductwork, fixtures, equipment and apparatus against dirty water, chemical or mechanical damage both before and after installation. Restore to its original condition or replace fixtures, equipment or apparatus damaged prior to final acceptance of work.
- F. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:
- 1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.
- G. Cut piping squarely, free of rough edges and reamed to full bore. Insert piping fully into fittings.
- H. Provide joints of type indicated in each piping system.
- I. Thread pipe in accordance with ANSI/ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Remove excess cutting oil from piping prior to assembly. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.
- J. Sleeves:
- 1. Pipe Sleeves:
    - a. Layout work in advance of pouring concrete, furnish, and set sleeves necessary to complete work.
    - b. Floor Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Extend sleeve 1-inch above finished floor. Caulk pipes passing through

- floor with non-shrinking grout or approved caulking compound (Except DWV Piping penetrating a concrete slab set on finish grade), provide "Link-Seal" sleeve sealing system for concrete/slab penetrations which are below grade. Caulk/seal piping passing through fire rated building assembly with UL rated assemblies. Provide fire-rated assemblies per local AHJ requirements
- c. Wall Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Provide sleeve flush with finished face of wall. Caulk pipes passing through walls with non-shrinking caulking compound. Provide modular link sealing system for concrete penetrations which are below grade. Caulk/seal piping passing through fire-rated assemblies per local AHJ requirements.
  - d. Beam Sleeves: Coordinate with trades for locations of pipe sleeves in reinforced concrete and steel beams. Indicate penetrations on structural shop drawings. See Drawings and Specifications for specific sleeve location limitations. Plumbing Drawings are diagrammatic. Offset piping as required to meet these limitations. Pipe sleeve locations must be indicated on reinforced concrete and steel beam shop drawings. Field cutting of beams not allowed without written approval of structural engineer. No extra costs allowed for failure to coordinate beam penetrations prior to reinforced concrete and steel beam shop drawing submittal.
2. Installation of metallic or plastic piping penetrations through non fire-rated walls and partitions and through smoke-rated walls and partitions:
    - a. Install fabricated pipe sleeve.
    - b. After installation of sleeve and piping, tightly pack entire annular void between piping or piping insulation and sleeve identification.
    - c. Seal each end airtight with a resilient nonhardening seal per code.
  3. Piping penetrations through fire-rated (1 to 3 hour) assemblies:
    - a. Select and install pre-engineered pipe penetration system in accordance with UL listing and manufacturer's recommendation.
    - b. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E84.

### **3.02 SANITARY, DRAINAGE (RAIN/STORMWATER) DWV PIPING, BURIED WITHIN 5-FEET OF BUILDING**

- A. Excavation and Backfill:
  1. See 3.01 above.
- B. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.
- C. Corrosive Soil Conditions:
  1. Wrap steel, iron, copper or other metal piping materials/fittings with Protecto Wrap 200, 30 mils or greater. Maintain a 1/2-inch overlap and install per manufacturer's requirements.
  2. Provide epoxy coated cast iron pipe and fittings for drainage systems.
- D. Cast-Iron Joints: Comply with coupling manufacturer's Cast Iron Soil Pipe Institute Standards and installation instructions.
- E. Sanitary and Storm Drainage:
  1. Grade piping at a uniform pitch of 2 percent unless otherwise noted on Drawings.
  2. Indirect Waste or Drain Piping: Extend piping to discharge as shown on Drawings. Maintain minimum air gap. Provide traps on indirect waste or drain piping exceeding 60-inches.

3. Fixture Carriers: Concealed fixture carriers for wall hung plumbing fixtures are specified in Section 22 40 00, Plumbing Fixtures.
  4. Drains:
    - a. Install drains to suit finished floor. Install drains and components per manufacturer's instructions. Slope flooring to floor drain or sink a minimum of 1/2-inch below finished floor elevation.
    - b. Install P-traps for hub drains, floor drains and floor sinks. P-traps to be of the same materials as soil and waste piping. Provide trap primer assembly for each drain or floor sink.
  5. Wall Access Panel: Secure to wall framing and install so that flange forms a close fitting joint with the finished wall surface.
  6. Heat trace and insulate P-traps exposed to freezing conditions. Provide heat trace and electronic components to Division 26 for installation.
  7. Insulate horizontal branch lines from floor sinks, receptors and drains receiving cold discharge from equipment and appliances.
- F. Epoxy Coated Cast Iron Pipe and Fittings: Coat the piping terminus of any cut piping with an applied epoxy per manufacturer's instructions. Denso Protal 7200 fast-cure epoxy repair coating.

### **3.03 SANITARY, DRAINAGE (RAIN/STORMWATER) DWV PIPING, ABOVE GRADE**

- A. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.
- B. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:
  1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.
- C. Solder copper tube and fitting joints with lead free nickel/silver bearing solder meeting ASTM Std. B-32, in accordance with IAPMO Is 3-93, ASTM B-828 and Copper Development Association recommended procedures. Clean joints by other than chemical means prior to assembly. "Shock" cooling is prohibited. Fluxes to be water soluble for copper and brass potable water applications, and meeting CDA standard test method 1.0 and ASTM B813-91. Apply solder until a full fillet is present around the joint. Do not apply solder and flux in such excessive quantities as to run down interior of pipe. Lead solder or corrosion flux not to be present at the jobsite.
- D. Cast-Iron Joints: Comply with coupling manufacturer's Cast Iron Soil Pipe Institute Standards and installation instructions.
- E. Sanitary and Storm Drainage:
  1. Grade piping at a uniform pitch of 2 percent unless otherwise noted on Drawings.
  2. Indirect Waste or Drain Piping: Extend piping to discharge as shown on Drawings. Maintain minimum air gap. Provide traps on indirect waste or drain piping exceeding 60-inches.
  3. Fixture Carriers: Concealed fixture carriers for wall hung plumbing fixtures are specified in Section 22 40 00, Plumbing Fixtures.
  4. Drains:
    - a. Install drains to suit finished floor or roof surface. Install drains and components per manufacturer's instructions. Slope flooring to floor drain or sink a minimum of 1/2-inch below finished floor elevation.

- b. Install P-traps for hub drains, floor drains and floor sinks. P-traps to be of the same materials as soil and waste piping. Provide trap primer assembly for each drain or floor sink.
5. Wall Access Panel: Secure to wall framing and install so that flange forms a close fitting joint with the finished wall surface.
6. Heat trace and insulate P-traps exposed to freezing conditions. Provide heat trace and electronic components to Division 26 for installation.
7. Insulate horizontal branch lines from floor sinks, receptors and drains receiving cold discharge from equipment and appliances.

### **3.04 PUMP WASTE PRESSURE PIPING (PUMPED DISCHARGE)**

- A. Excavation and Backfill:
  1. See 3.01 above.
- B. Testing of Pressurized Systems:
  1. Test each pressurized piping system at 150 percent of operating pressure indicated, but not less than 125 PSIG test pressure.
  2. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 2 percent of test pressure.
- C. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:
  1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.
- D. Braze copper tube and fitting socket with BCuP series filler metal without flux. Use listed brazing flux for joining of copper tube to brass or bronze fittings, meeting AWS FB3A or FB3C. "Shock" cooling is prohibited. A continuous fillet is to be visible around the completed joint. After cooling, thoroughly remove flux residue with warm water and a brush prior to testing. Do not use BCuP filler on copper alloys containing over 10 percent nickel. Cap or plug piping during construction to prevent entry of foreign material.
- E. Welders performing work under this Contract to be certified and qualified in accordance with tests prescribed by the National Certified Welding Bureau (NCWB) or by other approved test procedures using methodology and procedures covered in the ASME Boiler and Pressure Vessel Code, Section IX, "Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators". Installation to conform to ANSI 31.1 "Power Piping".
  1. Submit for approval the names, identification, and welder's assigned number, letter or symbol for welders assigned to this project.
  2. Use the assigned identification symbol to identify the work of each welder and indelibly stamp immediately upon completion of each weld.
  3. Welders to be tested and certified for all positions.
  4. Submit identifying stenciled test coupons made by each operator.
  5. Welders may be required to retake welding certification tests without additional expense.
  6. When so requested, a welder will not be permitted to work as a welder on this project until he has been recertified in accordance with NCWB.
  7. Recertification of the welder to be made after the welder has taken and passed the required tests.
- F. Weld pipe joints in accordance with recognized industry practice and as follows:
  1. Weld pipe joints only when ambient temperature is above 0F.
  2. Bevel pipe ends at a 37.5 degree angle where possible, smooth rough cuts, and clean to remove slag, metal particles, and dirt.
  3. Use pipe clamps or tack-weld joints with 1-inch long welds, 4 welds for pipe sizes to 10-inches, 8 welds for pipe sizes 12-inches to 20-inches.

4. Build up welds with a stringer-bead pass, followed by a hot pass, followed by a cover or filler pass. Eliminate valleys at center and at edges of each weld. Weld by procedures which will ensure elimination of unsound or unfused metal, cracks, oxidation, blow-holes, and non-metallic inclusions.
5. Do not weld out piping system imperfections by tack-welding procedures. Re-fabricate to comply with requirements.
6. At Installer's option, install forged branch-connection fittings whenever branch pipe is indicated, or install a regular T-fitting.

### **3.05 WATER PIPING, BURIED WITHIN 5-FEET OF BUILDING**

- A. Excavation and Backfill:
  1. See 3.01 above.
- B. Water Piping: Eliminate air from system. Fill and test at 125 PSIG or minimum 1-1/2 times static pressure at connection to serving utility main for period of two hours with no loss in pressure.
- C. Domestic Water:
  1. "Piping" to include pipes, fittings, nipples, valves and accessories connected thereto.
  2. Run piping generally parallel to the axis of the building, arranged to conform to the building requirements and to suit the necessities of clearance for other mechanical ducts, flues, conduits and work of other trades, and as close to ceiling or other construction as practical, free of unnecessary traps or bends.
  3. Grade water supply piping for complete drainage of the system. Install hose bibbs at low points.
  4. Use unions for piping connections to equipment.
  5. Provide sufficient elbows, swings and offsets to permit free expansion and contraction.
  6. Use reducers or increasers. Use no bushings.
  7. Ream or file each pipe to remove burrs. Inspect each length of pipe and each fitting for workmanship and clear passageways.
  8. Cover, cap or otherwise protect open ends of piping during construction to prevent damage to threads or flanges and prevent entry of foreign matter. Disinfect and sterilize water supply piping as specified. Furnish written report on final water quality results.
  9. Install exposed connections to equipment with special care, showing no tool marks or threads at fittings and piping. No bowed or bent piping permitted.
  10. Make ferrous to non-ferrous connections with dielectric fittings.
  11. Use extra heavy pipe for nipples, where unthreaded portion is less than 1-1/2-inches. Use no close nipples. Use only shoulder-type nipples.
  12. Through-Wall Pipes: Type 'L' copper tubing for through-wall pipes which connect to exposed stops at wall surface. Anchor the pipes in the wall; attach pipe with U-bolts to steel back-up plates or steel angles anchored in the wall. Provide wrought copper elbow which securely anchors ears in wall at through-wall pipes.
  13. Provide drain valves at base of risers and at low points on the system.
  14. Backflow Preventers: Pipe relief to nearest drain. Slope at 2 percent.
- D. Sterilization of Domestic Water System:
  1. General: Upon completion of tests and necessary replacements, thoroughly flush and disinfect domestic water piping.
  2. Method: After thoroughly flushing system with water to remove sediment, fill system with a solution containing 50 parts per million of chlorine for not less than 24 hours or 200 parts per million of chlorine for not less than 3 hours. After retention, drain, reflush and return system to service.
  3. Certification: Provide copy of domestic water chlorination certificate in each operations and maintenance manual.
  4. Provide water line disinfections performed by a licensed contractor with training in potable water line disinfections.

- E. Buried Pre-Insulated Pipe Installation:
  - 1. Installation and Testing: Install and test products in accordance with manufacturer's installation instructions.
  - 2. Manufacturer's installation instructions are to describe the following:
    - a. Storage and handling of pipes.
    - b. Trench preparation.
    - c. Installing pipe.
    - d. Installing accessories.
    - e. Installing fittings.
    - f. Building penetrations.
    - g. Field insulation kits.
    - h. Testing.

### **3.06 HOT AND COLD DOMESTIC WATER ABOVE GRADE**

- A. Water Piping: Eliminate air from system. Fill and test at 125 PSIG or minimum 1-1/2 times static pressure at connection to serving utility main for period of two hours with no loss in pressure.
- B. Testing of Pressurized Systems:
  - 1. Test each pressurized piping system at 150 percent of operating pressure indicated, but not less than 125 PSIG test pressure.
  - 2. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 2 percent of test pressure.
- C. Test hot and cold domestic water piping systems upon completion of rough-in and before connection to fixtures at hydrostatic pressure of 125 PSIG.
- D. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:
  - 1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.
- E. Solder copper tube and fitting joints with lead free nickel/silver bearing solder meeting ASTM Std. B-32, in accordance with IAPMO Is 3-93, ASTM B-828 and Copper Development Association recommended procedures. Clean joints by other than chemical means prior to assembly. "Shock" cooling is prohibited. Fluxes to be water soluble for copper and brass potable water applications, and meeting CDA standard test method 1.0 and ASTM B813-91. Apply solder until a full fillet is present around the joint. Do not apply solder and flux in such excessive quantities as to run down interior of pipe. Lead solder or corrosion flux not to be present at the jobsite.
- F. Braze copper tube and fitting socket with BCuP series filler metal without flux. Use listed brazing flux for joining of copper tube to brass or bronze fittings, meeting AWS FB3A or FB3C. "Shock" cooling is prohibited. A continuous fillet is to be visible around the completed joint. After cooling, thoroughly remove flux residue with warm water and a brush prior to testing. Do not use BCuP filler on copper alloys containing over 10 percent nickel. Cap or plug piping during construction to prevent entry of foreign material.
- G. Domestic Water:
  - 1. "Piping" to include pipes, fittings, nipples, valves and accessories connected thereto.
  - 2. Run piping generally parallel to the axis of the building, arranged to conform to the building requirements and to suit the necessities of clearance for other mechanical ducts, flues, conduits and work of other trades, and as close to ceiling or other construction as practical, free of unnecessary traps or bends.
  - 3. Grade water supply piping for complete drainage of the system. Install hose bibbs at low points.
  - 4. Use unions for piping connections to equipment.
  - 5. Provide sufficient elbows, swings and offsets to permit free expansion and contraction.

6. Use reducers or increasers. Use no bushings.
  7. Ream or file each pipe to remove burrs. Inspect each length of pipe and each fitting for workmanship and clear passageways.
  8. Cover, cap or otherwise protect open ends of piping during construction to prevent damage to threads or flanges and prevent entry of foreign matter. Disinfect and sterilize water supply piping as specified. Furnish written report on final water quality results.
  9. Install exposed connections to equipment with special care, showing no tool marks or threads at fittings and piping. No bowed or bent piping permitted.
  10. Make ferrous to non-ferrous connections with dielectric fittings.
  11. Use extra heavy pipe for nipples, where unthreaded portion is less than 1-1/2-inches. Use no close nipples. Use only shoulder-type nipples.
  12. Through-Wall Pipes: Type 'L' copper tubing for through-wall pipes which connect to exposed stops at wall surface. Anchor the pipes in the wall; attach pipe with U-bolts to steel back-up plates or steel angles anchored in the wall. Provide wrought copper elbow which securely anchors ears in wall at through-wall pipes.
  13. Provide drain valves at base of risers and at low points on the system.
  14. Backflow Preventers: Pipe relief to nearest drain. Slope at 2 percent.
- H. Installation of Press Fittings:
1. Make copper and copper alloy press connections in accordance with the manufacturer's installation instructions. Obtain training from the manufacturer's representative on the use and installation of the system.
  2. Visually examine fitting to ensure that sealing element is not damaged and that it is properly seated into the fitting. Fully insert tubing into the fitting. Mark the tubing with a felt tip pen at the face of the fitting to indicate fully seated fitting.
  3. Check fitting alignment against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting.
  4. Press joints using the tool(s) recommended by the manufacturer.
  5. Quality Assurance:
    - a. Pressure test to identify un-pressed connections. After press-connect fittings have been installed, perform a step test. Utilizing air or water, pressurize the system, not to exceed 85 psi.
    - b. If there is a significant drop in pressure, walk the system to check for un-pressed fittings. Should an un-pressed fitting be located, release the pressure from the system and press the un-pressed fitting. If no un-pressed fitting is identified, pressurize the system to test pressures required by code.
- I. Sterilization of Domestic Water System:
1. General: Upon completion of tests and necessary replacements, thoroughly flush and disinfect domestic water piping.
  2. Method: After thoroughly flushing system with water to remove sediment, fill system with a solution containing 50 parts per million of chlorine for not less than 24 hours or 200 parts per million of chlorine for not less than 3 hours. After retention, drain, reflush and return system to service.
  3. Certification: Provide copy of domestic water chlorination certificate in each operations and maintenance manual.
  4. Provide water line disinfections performed by a licensed contractor with training in potable water line disinfections.

### **3.07 CONDENSATE PIPING**

- A. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:
1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.

### **3.08 PRIMER PIPING**

- A. Excavation and Backfill:
  - 1. See 3.01 above.
- B. Testing:
  - 1. See 3.01 above.

### **3.09 PIPING SPECIALTIES**

- A. Excavation and Backfill:
  - 1. See 3.01 above.
- B. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.
- C. Corrosive Soil Conditions:
  - 1. Wrap steel, iron, copper or other metal piping materials/fittings with Protecto Wrap 200, 30 mils or greater. Maintain a 1/2-inch overlap and install per manufacturer's requirements.
  - 2. Provide epoxy coated cast iron pipe and fittings for drainage systems.
- D. Cast-Iron Joints: Comply with coupling manufacturer's Cast Iron Soil Pipe Institute Standards and installation instructions.

### **3.10 CLEANOUTS**

- A. Install in aboveground piping and building drain piping as indicated, as required by code; at each change in direction of piping greater than 135 degrees; at minimum intervals of 100-feet; and at base of each vertical soil or waste stack. Install floor and wall cleanout covers for concealed piping. Select type to match adjacent building finish. Provide shop drawings to Architect to coordinate locations and types of cleanouts with Architect prior to installation.

**END OF SECTION**



**SECTION 223000  
PLUMBING EQUIPMENT**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Commercial Light Duty Electric Storage Type Water Heaters
  - 2. Domestic Expansion Tanks Non-ASME
  - 3. Domestic Circulation Pumps - Close-Coupled, In-Line
  - 4. Duplex Sump Pump
  - 5. Submersible Pumps

**1.02 RELATED SECTIONS**

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Seismic anchor details and calculations signed and stamped by licensed Oregon structural engineer with equipment data.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. NSF 61, Annex G compliant.
  - 2. ISO 9001 Certified.
  - 3. IAPMO Low Lead Certification
- C. Products approved for installation by state authorizing agency, no exceptions.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

- A. Commercial Light Duty Electric Storage Type Water Heaters:
  - 1. Hubbell Series E
  - 2. A.O. Smith
  - 3. Bradford White
  - 4. Bock
  - 5. State
  - 6. Rheem/Ruud
  - 7. Or approved equivalent.
- B. Domestic Expansion Tanks Non-ASME:
  - 1. Bell and Gossett Series PT
  - 2. American Wheatley
  - 3. Amtrol

4. Armstrong
  5. Watts
  6. Or approved equivalent.
- C. Domestic Circulation Pumps - Close-Coupled, In-Line:
1. Bell and Gossett Series
  2. Armstrong
  3. Grundfos
  4. Paco
  5. Taco
  6. Or approved equivalent.
- D. Duplex Sump Pump - Oil Filled:
1. Acceptable Pump Manufacturers:
    - a. Grundfos
    - b. Goulds
    - c. Hydromatic
    - d. Liberty
    - e. Zoeller
    - f. Or approved equivalent.
  2. Acceptable Basin Manufacturer:
    - a. LFM
    - b. Canwest
    - c. Jackel
    - d. AK
    - e. Topp
    - f. Or approved equivalent.
- E. Submersible Pumps:
1. Oil Filled:
    - a. Grundfos
    - b. Goulds
    - c. Hydromatic
    - d. Liberty
    - e. Zoeller
    - f. Or approved equivalent.

## 2.02 GENERAL

- A. Reference drawings for capacities and specific model numbers.

## 2.03 COMMERCIAL LIGHT DUTY ELECTRIC STORAGE TYPE WATER HEATERS

- A. System: Domestic Hot Water
- B. Entire unit is to be delivered complete with operating controls and require only plumbing and electrical service connections.
- C. Tank welded steel commercial construction designed for 150 PSI. Tank is to be lined with seamless Hydrastone cement to minimum thickness of 1/2-inch on 100 percent of interior tank surfaces, tank to be fabricated from solid copper-silicon and not require any type of anodic protection. Tank designed and fabricated with non-ferrous copper-silicon threaded tapings and non-ferrous inlet and outlet piping for maximum corrosion resistance. Steel tank tapings will not be acceptable. Entire tank is to be insulated with minimum of 2-inches thick polyurethane foam insulation and exceed latest ASHRAE standard for stand-by heat loss. Complete heater supplied with high impact colorized composite protective jacket which cannot rust or corrode and does not require painting.

- D. Cold water inlet 3/4-inch Female NPT (1-1/2-inch Male NPT) and include non-corrosive strata-flow diffuser which prevents incoming cold water from mixing too rapidly with hot water in tank. 3/4-inch hose connection drain is supplied. Hot water outlet 3/4-inch Male NPT (1-1/2-inch Male NPT) and includes factory installed built-in heat trap to prevent water from radiating through piping during stand-by periods. Separate 3/4-inch Female NPT tapping is to be provided for relief valve installation. An ASME rated automatic reseating combination temperature and pressure safety relief valve set at 150 PSI and 210 degrees F factory supplied.

#### **2.04 DOMESTIC EXPANSION TANKS NON-ASME**

- A. Welded steel, constructed, tested and stamped in accordance with IAPMO Standards for working pressure of 125 PSI. Support floor mounted tanks with steel legs or base. Provide single flexible diaphragm securely sealed into tank to separate air charge from system water, to maintain design expansion capacity. Provide pressure gauge and air-charging fitting, and drain fitting. Diaphragm: Removable and replaceable in line.

#### **2.05 DOMESTIC CIRCULATION PUMPS - CLOSE-COUPLED, IN-LINE**

- A. System: Domestic water
- B. Description: Factory-assembled and tested, single-stage, close-coupled, in-line, seal-less centrifugal pump.
  - 1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge-type unit with motor and impeller on common shaft and designed for installation with pump and motor shaft mounted horizontally.
  - 2. Casing: Bronze/stainless steel, with threaded companion-flange connections.
  - 3. Impeller: Corrosion-resistant material.
  - 4. Motor: Non-overloading at any point on pump curve, Single speed, unless otherwise indicated. Comply with requirements in Division 22 Section "Common Motor Requirements."
- C. Capacities and Characteristics as per Drawings.
- D. See detail on Drawings for pump controls.

#### **2.06 DUPLEX SUMP PUMP**

- A. System: Storm Drain.
- B. Entire unit is to be delivered complete with operating controls and require only plumbing, gas and electrical service connections.
- C. Furnish and install where shown on Drawings, one duplex dewatering pump system to feed water feature.
- D. Pump casing to be one piece cast iron constructed with tripod support legs that provide an even distribution of weight.
- E. Mating surfaces between motor end bell, motor shell and seal chamber sealed by means of sectional quad rings. Designs using conventional circulate 'O' rings or rectangular cross sectional gaskets are not considered equal.
- F. Pump motor vertical, NEMA-6 and of an air filled, hermetically sealed design for premium efficiency. Oil filled shell not considered equal.
- G. Motor end bell cast iron, design as terminal box and separated from motor shell by combination bearings support and inspection plate.
- H. Motor housed within water tight, heavy duty cast iron with integral extended cooling fins. Motor have Class 'F' insulation and permanently lubricated, double sealed ball bearings having minimum life of 17,500 hours. Motors using sleeve type bearings not considered equal.
- I. Motor shaft to be 300 series stainless steel with keyway for positive positioning of impeller. Motors using carbon steel shafts or stainless stub shafts are not considered equal.

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- J. Impeller to be multi-vane design, constructed of bronze, accurately machined and dynamically balanced to job site conditions. Impeller will not require use of wearing rings to ensure proper operation and to be capable of passing 4-inch minimum solids.
- K. Double mechanical seal system to be furnished and housed in machined cast iron seal chamber filled with clean dielectric oil, providing constant lubrication. Lower seal surfaces to be of solid silicon carbide to provide longer life. Carbon ceramic, tungsten carbide or systems that allow lower seal surfaces to come in contact with pumped media, are not considered equal.
- L. Each pump to be tested and computer generated report will be kept in file and made available upon request. Reported test data consists of six duty points of various heads and capacities, one of which will be design point and includes actual efficiencies and horsepower requirements.
- M. Furnish remote packaged factory pre-wired duplex pump controller with following:
  - 1. NEMA 1 double door dead front steel lockable enclosure.
  - 2. Magnetic starter with overload reset through cover, each pump.
  - 3. Fused disconnect switch with handle through cover, each pump.
  - 4. Automatic alternator, separately fused with lead/lag/alternating capacity.
  - 5. Overload reset buttons, each pump.
  - 6. Running lights, each pump.
  - 7. H-O-A switches, each pump.
  - 8. Control circuit transformer for 120V operation for each pump.
  - 9. Output connections for hi-water annunciation.
  - 10. Alarm silencing switch.
  - 11. Alarm light with flasher.
  - 12. Numbered and wired terminal strip.
  - 13. Single point electrical connection.
  - 14. Wiring between control panel and pump provided under Division 22, Plumbing.
- N. Sump Basin:
  - 1. Concrete vault and access covers provided under Division 03, Concrete work.
- O. Basin Sump:
  - 1. Fabricate watertight, with sidewall openings for pipe connections.
  - 2. Material: FRP Fiberglass or Concrete.
  - 3. Reinforcement: Mounting plates for pumps, fittings, rail systems, and accessories.
  - 4. Anchor Flange: Same material as, or compatible with, basin sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.
- P. Basin Cover:
  - 1. Fabricate with openings with gaskets, seals, and bushings, for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.
  - 2. Material: Steel, with bitumastic coating or cast iron.
  - 3. Reinforcement: Steel or cast-iron reinforcement capable of supporting foot traffic.
- Q. Control Switches:
  - 1. Furnish and install mercury float switches complete with galvanized rod and wall support bracket. Each pump control switch to consist of 2 c normally open mercury switches, encapsulated in epoxy resin. Float casing to be polypropylene. Switch cable to be type STO PVC jacket 4 #18 conductor. 41 strand, 600 volt insulation. Cable secured to support rod with polypropylene composition clamp with stainless steel bolts. Switches used for high water alarm service to be of same construction as pump switches, except that 2 conductor cables will be furnished. Switch housing to be color coded to distinguish between pump and alarm switches.
- R. Operation of Pumps:
  - 1. See Drawings for switch elevation settings.
  - 2. Switch 1 turns lead pump off at 6-inches above bottom of vault.

## **2.07 SUBMERSIBLE PUMPS**

- A. System: Sanitary Sewer.
- B. Entire unit is to be delivered complete with operating controls and require only plumbing and electrical service connections.
- C. Provide submersible sump pump with 2-inch I.P.S. discharge, bronze fitted construction with submersible sealed motor, stainless steel shaft, bronze impeller, mechanical seal, waterproof 20-foot power cord and fully submersible float switch for mounting on pump discharge pipe.
- D. Provide check valve and shut-off valve on discharge side of pump.
- E. Provide steel basin cover for sump.

## **PART 3 - EXECUTION**

### **3.01 GENERAL**

- A. Examine areas and conditions under which equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Install equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- C. Orients so controls and devices needing service and maintenance have adequate access.
- D. Certificates: Submit appropriate Certificates of Shop Inspection and Data Report as required by provisions of ASME Boiler and Pressure Vessel Code.
- E. Connect water piping to units with shutoff valves and unions.
- F. Equipment Rigging: Heavy duty rigging eye bolts for Crosby Group swivel hoist rings installed over pump access covers for removal or maintenance.
- G. Equipment Start-Up:
  - 1. Start-up, test, and adjust equipment in accordance with manufacturer's start-up instructions. Check and calibrate controls.
  - 2. Start-up performed by authorized manufacturer's representative or agent. Provide credentials of start-up personnel to Architect and Owner's Authorized Representative for approval.
  - 3. Remove and replace filters when start-up testing is executed.
  - 4. Manufacturer adjusts operating parameters of equipment to compensate to elevation of 500-feet above sea level.
  - 5. Architect, Commissioning Agent, and Owner's Authorized Representative will be notified 10 days prior to start-up and will be present at start-ups.
  - 6. Provide written report from manufacturer's representative on results of start-up within 48 hours.
  - 7. Technical Training of maintenance staff includes two hours minimum per each piece of equipment.
  - 8. Seismic Verification:
    - a. Contractor will retain structural engineer who will submit stamped and signed anchoring and restraint details on plumbing equipment with submittal data in accordance with Division 22, Plumbing requirements.
    - b. Contractor's Structural Engineer will test and verify in writing that seismic restraints have been installed in accordance with their details.

### **3.02 COMMERCIAL LIGHT DUTY ELECTRIC STORAGE TYPE WATER HEATERS**

- A. Examine areas and conditions under which equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

- B. Install equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- C. Orients so controls and devices needing service and maintenance have adequate access.
- D. Certificates: Submit appropriate Certificates of Shop Inspection and Data Report as required by provisions of ASME Boiler and Pressure Vessel Code.
- E. Connect water piping to units with shutoff valves and unions.

### **3.03 DOMESTIC EXPANSION TANKS NON-ASME**

- A. Precharge tank per manufacturers recommendation.
- B. Examine areas and conditions under which equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.
- C. Install equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- D. Orients so controls and devices needing service and maintenance have adequate access.
- E. Certificates: Submit appropriate Certificates of Shop Inspection and Data Report as required by provisions of ASME Boiler and Pressure Vessel Code.
- F. Connect water piping to units with shutoff valves and unions.

### **3.04 DOMESTIC CIRCULATION PUMPS - CLOSE-COUPLED, IN-LINE**

- A. Install equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- B. Orients so controls and devices needing service and maintenance have adequate access.
- C. Connect water piping to units with shutoff valves and unions.
- D. Provide lift check valves 5 diameters downstream of pump discharge for circulating pumps piped in a parallel configuration.
- E. Equipment Start-Up:
  - 1. Start-up, test, and adjust equipment in accordance with manufacturer's start-up instructions. Check and calibrate controls.
  - 2. Architect, Commissioning Agent, and Owner's Authorized Representative will be notified 10 days prior to start-up and will be present at start-ups.
  - 3. Seismic Verification:
    - a. Contractor will retain structural engineer who will submit stamped and signed anchoring and restraint details on plumbing equipment with submittal data in accordance with Division 22, Plumbing requirements.
    - b. Contractor's Structural Engineer will test and verify in writing that seismic restraints have been installed in accordance with their details.

### **3.05 DUPLEX SUMP PUMP**

- A. Examine areas and conditions under which equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Install equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- C. Orients so controls and devices needing service and maintenance have adequate access.
- D. Certificates: Submit appropriate Certificates of Shop Inspection and Data Report as required by provisions of ASME Boiler and Pressure Vessel Code.

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- E. Connect water piping to units with shutoff valves and unions.
- F. Equipment Rigging: Heavy duty rigging eye bolts for Crosby Group swivel hoist rings installed over pump access covers for removal or maintenance.
- G. Equipment Start-Up:
  - 1. Start-up, test, and adjust equipment in accordance with manufacturer's start-up instructions. Check and calibrate controls.
  - 2. Start-up performed by authorized manufacturer's representative or agent. Provide credentials of start-up personnel to Architect and Owner's Authorized Representative for approval.
  - 3. Architect, Commissioning Agent, and Owner's Authorized Representative will be notified 10 days prior to start-up and will be present at start-ups.
  - 4. Technical Training of maintenance staff includes two hours minimum per each piece of equipment.

**3.06 SUBMERSIBLE PUMPS**

- A. Examine areas and conditions under which equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Install equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- C. Orients so controls and devices needing service and maintenance have adequate access.
- D. Certificates: Submit appropriate Certificates of Shop Inspection and Data Report as required by provisions of ASME Boiler and Pressure Vessel Code.
- E. Connect water piping to units with shutoff valves, check valves and unions.

**END OF SECTION**

**SECTION 224000  
PLUMBING FIXTURES**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. General Plumbing Fixtures:
    - a. China Fixtures, White Only
    - b. Faucet Fittings
    - c. Fiberglass Fixtures, White Only
    - d. Molded Resin or Stone Fixtures
    - e. Shower Valves
    - f. Stainless Steel Fixtures
  - 2. Carriers
  - 3. Electric Water Coolers
  - 4. Emergency Showers/Eyewash
  - 5. Fixture Trim
  - 6. Floor Drains
  - 7. Floor Sinks
  - 8. Flushometers - Water Closet/Urinal
  - 9. Hose Bibbs
  - 10. Roof/Overflow Drains
  - 11. Water Closet Seats
  - 12. Drain Boxes
  - 13. Water Supply Boxes

**1.02 RELATED SECTIONS**

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Comply with lead free (less than or equal to 0.25 percent) products in drinking water systems.
  - 2. NSF 61, Annex G, Drinking Water System Components, Compliant.
  - 3. ISO 9001, Quality Management Standard Certified.
  - 4. IAPMO Low Lead Certification.
  - 5. Provide fixtures, faucets and accessories to meet barrier free requirements of the governing code with respect to plumbing fixtures provided for the physically handicapped.
  - 6. Items approved for use by State of Oregon.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.



## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. "Or approved equivalent" as defined in 22 00 00, Plumbing Basic Requirements. Substitution process requirements apply to approved equivalent products.
- B. General Plumbing Fixtures: See Schedule on Drawings for type.
  - 1. China Fixtures - White Only:
    - a. American Standard
    - b. Briggs
    - c. Crane
    - d. Eljer
    - e. Kohler
    - f. Universal-Rundle
    - g. Or approved equivalent.
  - 2. Faucet Fittings:
    - a. Private:
      - 1) Chicago
      - 2) Delta Commercial
      - 3) Moen
      - 4) Speakman
      - 5) Symmons
      - 6) T&S Brass
      - 7) Or approved equivalent.
    - b. Public:
      - 1) American Standard
      - 2) Chicago
      - 3) Delta Commercial
      - 4) Moen Commercial
      - 5) Sloan
      - 6) Symmons
      - 7) T & S Brass
      - 8) Or approved equivalent.
  - 3. Fiberglass Fixtures - White Only:
    - a. Aqua-Glass
    - b. Briggs
    - c. Crane
    - d. Comfort Designs
    - e. Florestone
    - f. Hytec
    - g. Mustee
    - h. Universal-Rundle
    - i. Or approved equivalent.
  - 4. Molded Resin or Stone Fixtures:
    - a. Fiat
    - b. Mustee
    - c. Stern Williams
    - d. Or approved equivalent.
  - 5. Shower Valves:
    - a. Acorn
    - b. Chicago
    - c. Delta

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- d. Moen
- e. Powers
- f. Symmons
- g. Or approved equivalent.
- 6. Stainless Steel Fixtures:
  - a. Elkay
  - b. Haws
  - c. Just
  - d. Or approved equivalent.
- C. Carriers:
  - 1. JR Smith
  - 2. Zurn
  - 3. Or approved equivalent.
- D. Electric Water Coolers:
  - 1. Elkay
  - 2. Halsey-Taylor
  - 3. Haws
  - 4. Oasis
  - 5. Sunroc
  - 6. Or approved equivalent.
- E. Emergency Showers/Eyewash:
  - 1. Bradley
  - 2. Encon
  - 3. Guardian
  - 4. Haws
  - 5. Speakman
  - 6. Or approved equivalent.
- F. Fixture Trim:
  - 1. McGuire
  - 2. Dearborn Brass
  - 3. Oatey
  - 4. Or approved equivalent.
- G. Floor Drains:
  - 1. Mifab
  - 2. Sioux Chief
  - 3. Smith
  - 4. Wade
  - 5. Watts
  - 6. Zurn
- H. Floor Sinks:
  - 1. Commercial Enameling
  - 2. Mifab
  - 3. Sioux Chief
  - 4. Smith
  - 5. Wade
  - 6. Watts
  - 7. Zurn
  - 8. Or approved equivalent.
- I. Flushometers - Water Closet/Urinal:

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1. Delaney
  2. Sloan
  3. Zurn
  4. Or approved equivalent.
- J. Hose Bibbs:
1. Chicago
  2. JR Smith
  3. Mifab
  4. Wade
  5. Woodford
  6. Zurn
  7. Or approved equivalent.
- K. Roof/Overflow Drains:
1. JR Smith
  2. Mifab
  3. Sioux Chief
  4. Watts
  5. Zurn
  6. Or approved equivalent.
- L. Water Closet Seats:
1. Bemis
  2. Or approved equivalent.
- M. Drain Boxes:
1. Sioux Chief
  2. Or approved equivalent.
- N. Water Supply Boxes:
1. Sioux Chief
  2. Or approved equivalent.

## **2.02 GENERAL PLUMBING FIXTURES**

- A. Review substitution request requirements in Division 01, General Requirements and 22 00 00, Plumbing General Requirements.
- B. Reference Architectural Details for mounting height and location of fixtures.
- C. Provide factory fabricated fixtures of type, style and material indicated on the plumbing fixture connection schedule shown on the Drawings. For each type fixture, provide fixture manufacturer's standard trim, carrier, seats, and valves as indicated by their published product information; either as designed and constructed, or as recommended by manufacturer, or required for complete installation. Where more than one type is indicated, selection is installer's option; but, fixtures of same type must be furnished by a single manufacturer. Where type is not otherwise indicated, provide fixtures complying with governing regulations.
- D. Provide fixtures complete with fittings, supports, fastening devices, bolt caps, faucets, valves, traps, stops and appurtenances.

## **2.03 CARRIERS**

- A. Wall Hung Water Closets:
  1. Vertical: Zurn Z-1204-N4-X-50 or Z-1204-ND4-X-50 (JR Smith 230y-M54-M12 or 230DY-M54-M12). Adjustable vertical load siphon jet with 500 lb. capacity.
  2. Horizontal: Zurn ZE-1203-N4-X-50 or ZE-1203-ND4-X-50 (JR Smith 220 R or L-Y-M54-M12 or 220DY-M54-M12). Adjustable horizontal siphon jet with 500 lb. load capacity.

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- B. Wall Hung Urinal: Zurn Z-1218-WS or Z-1222-WS. (JR Smith 637). Coupling type or plate type with bearing plate 200 lb. capacity.
- C. Wall Hung Lavatory: Zurn Z-1231 (D). (JR Smith 700). Concealed arm or Plate type, 250 lb. capacity.
- D. Wall Hung Service Sink: Zurn Z-1218. (JR Smith 913/914). Coupling type. 300 lb. capacity.
- E. Wall Hung Drinking Fountain: Zurn Z-1225-BL (JR Smith 834-97-98). Plate type. 300 lb. capacity.
- F. Wall Hung Flushing Rim Clinic Sink: Zurn Z-1217 (JR Smith 0915-Y4-98). Coupling Type. 300 lb. capacity.

**2.04 ELECTRIC WATER COOLERS**

- A. See Schedule on Drawings for type.

**2.05 EMERGENCY SHOWERS/EYEWASH**

- A. Provide emergency showers/eyewash products that are compliant with ANSI Z358.1, Standards for Emergency Eyewashes and Shower Equipment.

**2.06 FIXTURE TRIM**

- A. Traps: Provide heavy duty commercial grade traps on fixtures except fixtures with integral traps. Exposed traps will be chromium plated cast brass or 17 gauge chromium plated brass tubing.
  - 1. Sink: McGuire 8912CDF.
  - 2. Lavatory: McGuire 8902CDF.
- B. Supplies and Stops: Lead free heavy duty commercial grade, chrome plated with brass stems. Stops: T-handle or Loose Key type.
  - 1. Lavatory: McGuire LFH2165LK.
  - 2. Sink: McGuire LFH2167LK.
  - 3. Water Closets: McGuire.
- C. Lavatory Grid Strainer: McGuire 155A.
- D. Sink Grid Strainer: McGuire 152N.
- E. Shower Grid Strainer: McGuire 1266.
- F. Sink Basket Strainer: McGuire 151.
- G. Trim barrier-free wrap for P-traps and supplies by McGuire, Pro-Wrap, Plumberex or True-bro.
- H. Escutcheons: McGuire wrought brass deep bell.
- I. Wax Rings and Toilet Bolts: WM Harvey No Seep No. 1 053065-N.

**2.07 FLOOR DRAINS**

- A. See Schedule on Drawings for types.

**2.08 FLOOR SINKS**

- A. See Schedule on Drawings for types.
- B. Plastic components are not allowed.

**2.09 FLUSHOMETERS - WATER CLOSET/URINAL**

- A. See Schedule on Drawings for types.

**2.10 HOSE BIBBS**

- A. See Schedule on Drawings for types.

**2.11 ROOF/OVERFLOW DRAINS**

- A. See Schedule on Drawings for type.

- B. Plastic components are not allowed.

#### **2.12 WATER CLOSET SEATS**

- A. See Schedule on Drawings for type.

#### **2.13 DRAIN BOXES**

- A. See Schedule on Drawings for type.
- B. Provide fire rated ASTM E-84 rated boxes where required by building construction.

#### **2.14 WATER SUPPLY BOXES**

- A. See Schedule on Drawings for type.
- B. Provide fire rated ASTM E-84 rated boxes where required by building construction.

### **PART 3 - EXECUTION**

#### **3.01 GENERAL PLUMBING FIXTURE INSTALLATION INFORMATION**

- A. Verification of Conditions:
  1. Examine rough-in work of water supply and waste piping systems to verify actual locations of piping connections prior to installing fixtures. Examine floors and substrates, and conditions under which fixture work is to be accomplished. Correct any incorrect locations of piping and other unsatisfactory conditions for installation of plumbing fixtures.
  2. Examine walls, floors and cabinets for suitable conditions where fixtures are to be installed.
  3. Install plumbing fixtures level and plumb, in accordance with fixture manufacturer's written instructions, rough-in drawings and pertinent codes and regulations, design and referenced standards.
  4. Fasten plumbing fixtures securely to supports or building structure. Secure supplies behind or within wall construction to provide rigid installation.
  5. Install a stop valve in a readily accessible location in water connection to each fixture.
  6. Install escutcheons at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
  7. Seal fixtures to walls and floors using silicone sealant Dow Corning No. 780 or approved equivalent. Match sealant color to fixture color.
  8. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning units, then retest.
  9. Inspect each unit for damage prior to installation. Replace damaged fixtures.
  10. Replace washers or cartridges of leaking or dripping faucets and stops.
  11. Clean fixtures, trim and strainers using manufacturer's recommended cleaning methods and materials.
  12. During construction, cover installed fixtures, drains, sinks and water coolers with cardboard and wrap with sheet plastic.
  13. Provide trap primers for floor drains, floor sinks, trench drains and hub drains.
  14. Install roof and overflow roof drains per architectural details. Cover drains during roof construction to protect drain. Provide offsets or expansion joints at each roof/overflow drain.
  15. Do not use lead flashing.
- B. Owner Furnished Equipment:
  1. Rough-in and make final connections to Owner furnished equipment. Provide necessary items to complete installation.
  2. Comply with requirements of this Section and Drawings for installation procedures.
- C. Adjusting and Cleaning: Clean plumbing fixtures, trim, and strainers of dirt and debris upon completion of installation. Adjust water pressure at drinking fountains, faucets, shower valves and flush valves to provide proper flow stream and specified GPM. Repair leaks at faucets and

stops.

- D. Extra Stock: Furnish special wrenches and other devices necessary for servicing plumbing fixtures and trim to Owner.
- E. Field Quality Control: Upon completion of installation of plumbing fixtures, test fixtures to demonstrate capability and compliance with Specifications. Correct or replace malfunctioning units at site, then retest to demonstrate compliance.
- F. Protection: Protect fixtures and equipment from damage. Cover finished fixtures with cardboard and sheet plastic. Fixtures are not to be used during construction. Replace damaged items with new.
- G. Signage: For fixtures that do not have ASSE 1070 mixing valve protection for hot water temperature, provide signage per Section 22 05 53, Identification for Plumbing Piping and Equipment.

### **3.02 CARRIERS INSTALLATION**

- A. Install components in accordance with manufacturer's instructions and approved product data submittals.
- B. Set plumb, level and rigid.
- C. Coordinate wall thickness so carrier has adequate depth to be concealed.

### **3.03 ELECTRIC WATER COOLER INSTALLATION**

- A. Install components in accordance with manufacturer's instructions and approved product data submittals.
- B. Set plumb, level and rigid.

### **3.04 EMERGENCY SHOWERS/EYEWASH INSTALLATION**

- A. Install components in accordance with manufacturer's instructions and approved product data submittals.
- B. Set plumb, level and rigid.

### **3.05 FIXTURE TRIM INSTALLATION**

- A. Install components in accordance with manufacturer's instructions and approved product data submittals.
- B. Set plumb, level and rigid.

### **3.06 FLOOR DRAINS INSTALLATION**

- A. Install components in accordance with manufacturer's instructions and approved product data submittals.
- B. Set plumb, level and rigid.

### **3.07 FLOOR SINK INSTALLATION**

- A. Install components in accordance with manufacturer's instructions and approved product data submittals.
- B. Set plumb, level and rigid. Set fixture rim/grate flush with surrounding finish surface unless specifically noted otherwise.

### **3.08 FLUSHOMETERS - WATER CLOSET/URINAL INSTALLATION**

- A. Install components in accordance with manufacturer's instructions and approved product data submittals.
- B. Set plumb, level and rigid.

**3.09 HOSE BIBB INSTALLATION**

- A. Install components in accordance with manufacturer's instructions and approved product data submittals.
- B. Set plumb, level and rigid.

**3.10 ROOF/OVERFLOW DRAINS INSTALLATION**

- A. Install components in accordance with manufacturer's instructions and approved product data submittals.
- B. Set plumb, level and rigid.

**3.11 WATER CLOSET SEAT INSTALLATION**

- A. Install components in accordance with manufacturer's instructions and approved product data submittals.
- B. Set plumb, level and rigid.

**3.12 DRAIN BOX INSTALLATION**

- A. Install components in accordance with manufacturer's instructions and approved product data submittals.
- B. Set plumb, level and rigid.

**3.13 WATER SUPPLY BOX INSTALLATION**

- A. Install components in accordance with manufacturer's instructions and approved product data submittals.
- B. Set plumb, level and rigid.

**END OF SECTION**

**SECTION 230000**  
**HEATING, VENTILATING AND AIR CONDITIONING (HVAC) BASIC REQUIREMENTS**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Work included in 23 00 00, HVAC Basic Requirements applies to Division 23, HVAC work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of heating, ventilating and air conditioning systems for proposed project.
- B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.
- C. Definitions:
  - 1. Provide: To furnish and install, complete and ready for intended use.
  - 2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
  - 3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work provided.
  - 4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent", substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.
  - 5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's Authorized Representative, and other reviewing entity whose approval is required to obtain systems acceptance.

**1.02 RELATED SECTIONS**

- A. Contents of Section applies to Division 23, HVAC Contract Documents.
- B. Related Work:
  - 1. Additional conditions apply to this Division including, but not limited to:
    - a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
    - b. Drawings
    - c. Addenda
    - d. Owner/Architect Agreement
    - e. Owner/Contractor Agreement
    - f. Codes, Standards, Public Ordinances and Permits

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards per Division 01, General Requirements, individual Division 23, HVAC Sections and those listed in this Section.
- B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, off/from:
  - 1. State of Oregon:
    - a. OAR - Oregon Administrative Rules
    - b. 2021 OESC - Oregon Electrical Specialty Code
    - c. 2019 OFC - Oregon Fire Code
    - d. 2019 OMSC - Oregon Mechanical Specialty Code
    - e. 2021 OPSC - Oregon Plumbing Specialty Code
    - f. 2019 OSSC - Oregon Structural Specialty Code



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- g. 2021 OEESC - Oregon Energy Efficiency Specialty Code
  - h. 2011 Oregon Elevator Specialty Code
- C. Reference standards and guidelines include but are not limited to the latest adopted editions from:
- 1. ABA - Architectural Barriers Act
  - 2. ABMA - American Bearing Manufacturers Association
  - 3. ADA - Americans with Disabilities Act
  - 4. AHRI - Air-Conditioning Heating & Refrigeration Institute
  - 5. AMCA - Air Movement and Control Association
  - 6. ANSI - American National Standards Institute
  - 7. ASCE - American Society of Civil Engineers
  - 8. ASHRAE - American Society of Heating, Refrigeration and Air-Conditioning Engineers
  - 9. ASHRAE Guideline 0, The Commissioning Process
  - 10. ASME - American Society of Mechanical Engineers
  - 11. ASPE - American Society of Plumbing Engineers
  - 12. ASSE - American Society of Sanitary Engineering
  - 13. ASTM - ASTM International
  - 14. AWWA - American Water Works Association
  - 15. CFR - Code of Federal Regulations
  - 16. CGA - Compressed Gas Association
  - 17. CISPI - Cast Iron Soil Pipe Institute
  - 18. EPA - Environmental Protection Agency
  - 19. ETL - Electrical Testing Laboratories
  - 20. FM - FM Global
  - 21. GAMA - Gas Appliance Manufacturers Association
  - 22. HI - Hydraulic Institute Standards
  - 23. IAPMO - International Association of Plumbing & Mechanical Officials
  - 24. IFGC - International Fuel Gas Code
  - 25. ISO - International Organization for Standardization
  - 26. MSS - Manufacturers Standardization Society
  - 27. NEC - National Electric Code
  - 28. NEMA - National Electrical Manufacturers Association
  - 29. NFPA - National Fire Protection Association
  - 30. NFGC - National Fuel Gas Code
  - 31. NRCA - National Roofing Contractors Association
  - 32. NSF - National Sanitation Foundation
  - 33. OSHA - Occupational Safety and Health Administration
  - 34. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association, Inc.
  - 35. TEMA - Tubular Exchanger Manufacturers Association
  - 36. TIMA - Thermal Insulation Manufacturers Association
  - 37. UL - Underwriters Laboratories, Inc.
- D. See Division 23, HVAC individual Sections for additional references.

**1.04 SUBMITTALS**

- A. See Division 01, General Requirements for Submittal Procedures as well as specific individual Division 23, HVAC Sections.
- B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.
- C. In addition:
  - 1. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for

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conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.

2. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via zip file via e-mail and be native/searchable PDF format. Scanned copies are not acceptable. For electronic format, provide one file per division containing one bookmarked PDF file with each bookmark corresponding to each Specification Section. Arrange bookmarks in ascending order of Specification Section number. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. All transmissions/submissions to be submitted to Architect. At Contractor's option, four separate submittals may be provided, consisting of long lead items, underground/site work, building work, and building automation system. Deviations will be returned without review.
3. Product Data: Provide Manufacturer's descriptive literature for products specified in Division 23, HVAC Sections.
4. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the Specifications and Drawings.
  - a. Label submittal to match numbering/references as shown in Contract Documents. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
  - b. Include technical data, installation instructions and dimensioned drawings for products, fixtures, equipment and devices installed, furnished or provided. Reference individual Division 23, HVAC Specification Sections for specific items required in product data submittal outside of these requirements.
  - c. Provide pump curves, operation characteristics, capacities, ambient noise criteria, etc. for equipment.
  - d. For vibration isolation of equipment, list make and model selected with operating load and deflection.
  - e. See Division 23, HVAC individual Sections for additional submittal requirements outside of these requirements.
5. Maximum of two reviews of submittal package. Arrange for additional reviews and/or early review of long-lead items; Bear costs of these additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.
6. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer's comments. Identify Engineer's comments and provide an individual response to each of the Engineer's comments. Cloud changes in the submittals and further identify changes which are in response to Engineer's comments.
7. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet ASCE 7-16 requirements for non-structural components. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.
8. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required by Division 23, HVAC Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical submittals.

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9. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.
10. Substitutions and Variation from Basis of Design:
  - a. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
  - b. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals". For any product marked "or approved equivalent", a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.
11. Shop Drawings: Provide coordinated shop drawings which include physical characteristics of all systems, equipment, ductwork and piping layout plans, and control wiring diagrams. Reference individual Division 23, HVAC Specification Sections for additional requirements for shop drawings outside of these requirements.
  - a. Provide Shop Drawings indicating access panel locations for items that require Code or maintenance access, size and elevation for approval prior to installation.
12. Samples: Provide samples when requested by individual Sections.
13. Resubmission Requirements:
  - a. Make any corrections or change in submittals when required. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Cloud changes in the submittals.
    - 1) Resubmit for review until review indicates no exception taken or make "corrections as noted".
    - 2) When submitting drawings for Engineers re-review, clearly indicate changes on drawings and "cloud" any revisions. Submit a list describing each change.
14. Operation and Maintenance Manuals, Owner's Instructions:
  - a. Submit, at one time, electronic files (native/searchable PDF format) of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Include valve charts. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.
    - 1) Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
    - 2) Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, quantities, relevant to each piece of equipment: belts, motors, lubricants, and filters.
    - 3) Include Warranty per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 23 00 00, HVAC Basic

- Requirements and individual Sections.
- 4) Include product certificates of warranties and guarantees.
  - 5) Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub assemblies.
  - 6) Include copy of startup and test reports specific to each piece of equipment.
  - 7) Include copy of final air and water systems balancing log along with pump, fan and distribution system operating data.
  - 8) Include commissioning reports.
  - 9) Include copy of valve charts/schedules.
  - 10) Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.
- b. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 23 00 00, HVAC Basic Requirements Article titled "Demonstration".
  - c. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.
15. Record Drawings:
- a. Maintain at site at least one set of drawings for recording "As-constructed" conditions. Indicate on drawings changes to original documents by referencing revision document, and include buried elements, location of cleanouts, and location of concealed mechanical items. Include items changed by field orders, supplemental instructions, and constructed conditions.
  - b. Record Drawings are to include equipment and fixture/connection schedules, control dampers, fire smoke dampers, fire dampers, valves, bottom of pipe, duct and equipment elevations and dimensioned locations for all distribution systems (hydronic and air). Invert elevations and dimensioned locations for underground systems below grade to 5-feet outside building that accurately reflect "as constructed or installed" for project.
  - c. At completion of project, input changes to original project CAD Drawings and make one set of black-line drawings created from CAD Files in version/release equal to contract drawings. Submit CAD Files and drawings upon substantial completion.
  - d. See Division 23, HVAC individual Sections for additional items to include in record drawings.

#### 1.05 QUALITY ASSURANCE

- A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.
- B. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.
- C. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturer's equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e., piping) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire

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sprinkler, and plumbing systems.

- D. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.
- E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.
- F. Provide products that are UL listed.
- G. Piping and duct insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.
- H. ASME Compliance: ASME listed water heaters and boilers with an input of 200,000 BTUH and higher, hot water storage tanks which exceed 120 gallons, and hot water expansion tanks which are connected to ASME rated equipment or required by code or local jurisdiction.
- I. Provide safety controls required by National Boiler Code (ASME CSD 1) for boilers and water heaters with an input of 400,000 BTUH and higher.

#### **1.06 WARRANTY**

- A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Contracting and Procurement Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty under Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

#### **1.07 COORDINATION DOCUMENTS**

- A. Prior to construction, prepare and submit coordinated layout drawings (composite drawings), to coordinate installation and location of ductwork, grilles, diffusers, piping, fire sprinklers, plumbing, lights, and electrical services. Composite Drawings show services on single sheet. Key Drawings to structural column identification system. Prior to completion of Drawings, coordinate proposed installation with architectural and structural requirements, and other trades (including plumbing, HVAC, fire protection, electrical, ceiling suspension, and ceiling tile systems, etc.), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence.
- B. Prepare Drawings as follows:
  - 1. Drawings in CAD Format. CAD format release equal to design documents. Drawings to be same sheet size and scale as Contract Drawings and indicate location, size and elevation above finished floor of equipment and distribution systems.
  - 2. Review and revise, as necessary, section cuts in Contract Drawings after verification of field conditions.
  - 3. Indicate hydronic and air distribution system piping including fittings, hangers, access panels, valves, and bottom of pipe and duct elevations above finished floor.
  - 4. Indicate inverts and provision for piping that must be graded to have right-of-way over more flexible items. Drawings also to indicate proposed ceiling grid and lighting layout as shown on electrical drawings and architectural reflected ceiling drawings and HVAC equipment, ductwork and piping.
  - 5. Incorporate Addenda items and change orders.
  - 6. Distribute drawings to trades and provide additional coordination as requested by other trades.
- C. Advise Architect in event conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.

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- D. Verify in field exact size, location, invert, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.
- E. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer, including but not limited to pumps, fans, valves, control devices, air handlers, vibration isolation devices, etc.

### **2.02 STANDARDS OF MATERIALS AND WORKMANSHIP**

- A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL or ETL listed and labeled or be approved by State, County, and City authorities prior to procurement and installation.
- B. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
- C. Hazardous Materials:
  - 1. Comply with local, State of Oregon, and Federal regulations relating to hazardous materials.
  - 2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
  - 3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

### **2.03 ACCESS PANELS**

- A. See Division 01, General Requirements and Division 08, Openings for products and installation requirements.
- B. Confirm Access Panel requirements in Division 01, General Requirements, Division 08, Openings and individual Division 23, HVAC Sections. In absence of specific requirements in Division 01, General Requirements, comply with the following:
  - 1. Provide flush mounting access panels for service of systems and individual components requiring maintenance or inspection. Where access panels are located in fire-rated assemblies of building, rate access panels accordingly.
    - a. Ceiling access panels to be minimum 24-inch by 24-inch required and approved size.
    - b. Wall access panels to be minimum of 12-inch by 12-inch required and approved size.
    - c. Provide screwdriver operated catch.
    - d. Manufacturers and Models:
      - 1) Drywall: Karp KDW.
      - 2) Plaster: Karp DSC-214PL.
      - 3) Masonry: Karp DSC-214M.
      - 4) 2 hour rated: Karp KPF-350FR.
      - 5) Manufacturers: Milcor, Elmdor, Acudor or approved equivalent.

## **PART 3 - EXECUTION**

### **3.01 ACCESSIBILITY AND INSTALLATION**

- A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

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- B. Install equipment having components requiring access (i.e., drain pans, drains, control operators, valves, motors and vibration isolation devices) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.
- C. Install equipment and products complete as directed by manufacturer's installation instructions including all appurtenances recommended in manufacturer's installation instructions, at no additional charge to Owner. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing and coordination with other trades and disciplines.
- D. Earthwork:
  - 1. Confirm Earthwork requirements in Contract Documents. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
    - a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with related earthwork Sections. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
    - b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
    - c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.
- E. Firestopping:
  - 1. Confirm Firestopping requirements in Division 07, Thermal and Moisture Protection. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
    - a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping, ductwork and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- F. Pipe Installation:
  - 1. Provide installation of piping systems coordinated to account for expansion and contraction of piping materials and building, as well as anticipated settlement or shrinkage of building. Install work to prevent damage to piping, equipment, and building and its contents. Provide piping offsets, loops, seismic flexible joints, expansion joints, sleeves, anchors or other means to control pipe movement and minimize forces on piping. Verify anticipated settlement and/or shrinkage of building with Project Structural Engineer. Verify construction phasing, type of building construction products and rating for coordinating installation of piping systems.
  - 2. Include provisions for servicing and removal of equipment without dismantling piping.
- G. Plenums:
  - 1. Plenums: Materials within plenums shall be noncombustible or shall have a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E 84 or UL 723. Immediately notify Architect / Engineer of any discrepancy.

### 3.02 SEISMIC CONTROL

- A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, and individual Division 23 HVAC Sections.
- B. General:

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1. Earthquake resistant designs for HVAC (Division 23) equipment and distribution, i.e. motors, ductwork, piping, equipment, etc. to conform to regulations of jurisdiction having authority.
  2. Restraints which are used to prevent disruption of function of piece of equipment because of application of horizontal force to be such that forces are carried to frame of structure in such a way that frame will not be deflected when apparatus is attached to a mounting base and equipment pad, or to structure in normal way, utilizing attachments provided. Secure equipment and distribution systems to withstand a force in direction equal to value defined by jurisdiction having authority.
  3. Provide stamped Shop Drawings from licensed Structural Engineer of seismic bracing and seismic movement assemblies for piping equipment and water heaters. Submit Shop Drawings along with equipment submittals.
  4. Provide stamped Shop Drawings from licensed Structural Engineer of seismic flexible joints for piping and crossing building expansion or seismic joints. Submit Shop Drawings along with seismic bracing details.
- C. Piping and Ductwork:
1. Per "Seismic Restraints Manual Guidelines for Mechanical Systems" latest edition published by SMACNA or local requirements.
- D. Provide means to prohibit excessive motion of mechanical equipment during earthquake.

### 3.03 REVIEW AND OBSERVATION

- A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:
1. Underground system installation prior to backfilling.
  2. Prior to covering walls.
  3. Prior to ceiling cover/installation.
  4. After major equipment is installed.
  5. When main systems, or portions of, are being tested and ready for inspection by AHJ.
- C. Final Punch:
1. Prior to requesting a final punch visit from the Engineer, request from Engineer the Mechanical Precloseout Checklist, complete the checklist confirming completion of systems' installation, and return to Engineer. Request a final punch visit from the Engineer, upon Engineer's acceptance that the mechanical systems are ready for final punch.
  2. Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

### 3.04 CONTINUITY OF SERVICE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
1. During remodeling or addition to existing structures, while existing structure is occupied, current services to remain intact until new construction, facilities or equipment is installed.
  2. Prior to changing over to new service, verify that every item is thoroughly prepared. Install new piping and ductwork, and wiring to point of connection. Where existing systems are being utilized, clean existing distribution systems (ductwork, piping, fans, air handlers) prior to connecting new ductwork or piping.
  3. Coordinate transfer time to new service with Owner. If required, perform transfer during off peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum.



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- a. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
4. Organize work to minimize duration of power interruption.

### **3.05 CUTTING AND PATCHING**

- A. Confirm Cutting and Patching requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
  1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
  2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.
  3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.
  4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of this project. Where alterations disturb lawns, paving, and walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.
  5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

### **3.06 EQUIPMENT SELECTION AND SERVICEABILITY**

- A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.
- B. Maintain design intent where equipment other than as shown as Basis of Design in Contract Documents is provided. Where equipment requires ductwork or piping arrangement, controls/control diagrams, or sequencing different from that indicated in Contract Documents, provide at no additional cost to Owner.

### **3.07 DELIVERY, STORAGE AND HANDLING**

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
  1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust. Insulation and lining that becomes wet from improper storage and handling to be replaced before installation. Products and/or materials that become damaged due to water, dirt, and/or dust as a result of improper storage to be replaced before installation.
  2. Protect equipment and pipe to avoid damage. Close pipe openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
  3. Protect bright finished shafts, bearing housings and similar items until in service.

### **3.08 DEMONSTRATION**

- A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

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- B. Upon completion of work and adjustment of equipment and test systems, demonstrate to Owner's Authorized Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

### **3.09 CLEANING**

- A. Confirm Cleaning requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Upon completion of installation, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

### **3.10 INSTALLATION**

- A. Confirm Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Install equipment and fixtures in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.
- C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
  - 1. Do not place equipment in sustained operation prior to initial balancing of HVAC systems.
- D. Provide miscellaneous supports/metals required for installation of equipment, piping and ductwork.

### **3.11 PAINTING**

- A. Confirm Painting requirements in Division 01, General Requirements and Division 09, Finishes. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
  - 1. Ferrous Metal: After completion of work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces in mechanical rooms, i.e., hangers, hanger rods, equipment stands, with one coat of black asphalt varnish for exterior or black enamel for interior, suitable for hot surfaces.
  - 2. After acceptance by Authority Having Jurisdiction (AHJ), In a mechanical room, on roof or other exposed areas, machinery and equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
  - 3. See individual equipment Specifications for other painting.
  - 4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
  - 5. Piping and Ductwork: Clean, primer coat and paint exposed piping and ductwork on roof or at other exterior locations with two coats paint suitable for metallic surfaces and exterior exposures. Color selected by Architect.
  - 6. Covers: Covers such as manholes, cleanouts and the like will be furnished with finishes which resist corrosion and rust.

### **3.12 ACCESS PANELS**

- A. Confirm Access Panel requirements in Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
  - 1. Coordinate locations/sizes of access panels with Architect prior to work.

### **3.13 DEMOLITION**

- A. Confirm requirements in Division 01, General Requirements and Division 02, Existing Conditions. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
  - 1. Scope:
    - a. It is the intent of these documents to provide necessary information and adjustments to the HVAC system required to meet code, and accommodate installation of new work.
    - b. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access or access to different areas.
    - c. Existing Conditions: Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to exactly locate and preserve utilities. Replace damaged items with new material to match existing. Promptly notify Owner if utilities are found which are not shown on Drawings.
  - 2. Equipment: Unless otherwise directed, equipment, fixtures, or fittings being removed as part of demolition process are Owner's property. Remove other items not scheduled to be reused or relocated from job site as directed by Owner.
  - 3. Unless specifically indicated on Drawings, remove exposed, unused ductwork and piping to behind finished surfaces (floor, walls, ceilings, etc.). Cap and patch surfaces to match surrounding finish.
  - 4. Unless specifically indicated on Drawings, remove unused equipment, fixtures, fittings, rough-ins, and connectors. Removal is to be to a point behind finished surfaces (floors, walls, and ceilings).

### **3.14 ACCEPTANCE**

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
  - 1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
    - a. Testing and Balancing Reports
    - b. Cleaning
    - c. Operation and Maintenance Manuals
    - d. Training of Operating Personnel
    - e. Record Drawings
    - f. Warranty and Guaranty Certificates
    - g. Start-up/Test Document
    - h. Commissioning Reports

### **3.15 FIELD QUALITY CONTROL**

- A. Confirm Field Quality Control requirements in Division 01, General Requirements, Section 33 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Tests:
  - 1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in Operation and Maintenance Manuals.

2. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

### **3.16 LETTER OF CONFORMANCE**

- A. Provide Letter of Conformance, copies of manufacturers' warranties and extended warranties with a statement that HVAC items were installed in accordance with manufacturer's recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in Operation and Maintenance Manuals.

### **3.17 ELECTRICAL INTERLOCKS**

- A. Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, utilize equipment wiring diagrams to coordinate with electrical systems so that proper wiring of equipment involved is affected.

### **3.18 TEMPORARY HEATING, COOLING AND HUMIDITY CONTROL**

- A. Provide temporary heating, cooling, controls, humidification and dehumidification as required to facilitate the construction of the project. Size and select temporary system based on the requirements of the various trades during construction. This includes, but is not limited to, drywall, case work, wood flooring and wood finishes that are subject to warping. Size and install system to prevent mold growth. Coordinate the location of the temporary system. The house system can be used. Develop a procedure for how the house system will be used including a sketch depicting the house system, how filtration will be used to prevent construction debris from entering the system and how often the filters will be changed, how the ductwork will be cleaned after use to ensure a clean system is turned over to the Owner and how the units are sized. Submit this procedure to the Mechanical Engineer for review. Follow National Air Duct Cleaners Association (NADCA) duct cleaning procedures and guidelines. Warranties for the house system, if new, to commence when the Owner moves in if house system is used as the means to maintain the climate within the building during construction. Include this warranty requirement in the original bid or proposal amount. Coordinate and provide any temporary power, controls, ductwork, piping, plumbing anchorage, miscellaneous steel and structural supports required to support the temporary system. Installation of the system to comply with all applicable codes and be acceptable to the Authority Having Jurisdiction (AHJ).

**END OF SECTION**

**SECTION 230513  
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Starters
  - 2. Shaft Grounding

**1.02 RELATED SECTIONS**

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. NEMA Premium Efficiency
  - 2. Energy Policy Act (EPACT), latest applicable version(s) for minimum motor efficiencies.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Field Installed Motors: Installed motors to be of single type, from one source and from a single manufacturer.
  - 2. Electrical components and materials to be UL and ETL listed/labeled as suitable for location and use.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

- A. Starters:
  - 1. Cerus
  - 2. Eaton Electrical
  - 3. General Electric
  - 4. Siemens
  - 5. Schneider Electric/Square D
  - 6. Or approved equivalent.
- B. Shaft Grounding:
  - 1. Shaft Grounding Inc.
  - 2. Aegis SGR Bearing Protection Ring
  - 3. Or approved equivalent.

**2.02 STARTERS**

- A. Single Phase Motors:

1. Manual across-the-line starting switch having toggle-operated switch pilot running light and built-in thermal overload device with heating element rated not more than 115 percent motor full load current indicated on name plate of motor to be protected. Surface mount starters. Provide NEMA-1 enclosure.
  2. Overload relays to be melting alloy type with a replaceable control circuit module. Thermal units to be interchangeable. Starter to be non operative if thermal unit is removed.
  3. Single-phase motors with automatic controls. Provide motor-rated relay with coils rated for control voltage.
- B. Starters up to Size 8 to be suitable for the addition of a minimum of three external auxiliary contacts (normally open or normally closed). Contactor, coils, and relays to perform the control functions of the associated equipment and control sequence.
- C. Three Phase Motors up to and Including 15 HP:
1. Provide enclosed type magnetic across-the-line starter with thermal overload and undervoltage protection.
  2. Operator: "Start-Stop" pushbutton, except where automatic control is indicated on Drawings or specified. Then provide "Hand-Off-Auto" selector switch.
  3. Starters for 3-phase motors to have overload protection in each of the three legs, with external manual reset.
  4. Unless indicated on Drawings or in Specifications, furnish motor starters with a neon pilot light. Neon lights are required for exhaust fan switches.
  5. Equip starters with integral transformer and coil for control circuit. Coordinate coil voltage with control voltage.

### **2.03 SHAFT GROUNDING**

- A. Variable Speed Motor Shaft Grounding: Shaft grounding ring; solid ring type.
- B. Provide shaft grounding assembly on motors controlled by variable frequency drive. Shaft grounding device to be in the form of brush that resides on the motor shaft. Brush assembly shall be capable of tolerating misalignment and maintaining rotating contact throughout the motors life.
- C. Material: Material used in the grounding assembly shall be stable material commonly used within industry that is not believed to constitute a hazardous material under Occupational Safety & Health Administration (OSHA) regulations.
- D. Brushes: Specifically developed carbon compounds of sustained performance with wear life expectancy of 3 years minimum.
- E. Seals: Sealed type to keep contaminants from entering the shaft grounding system in wet or severe environment applications.
- F. Shaft Grounding Assembly: For clean room air handling systems, use the type that contains the wear products within a special enclosure within the shaft grounding system.

## **PART 3 - EXECUTION**

### **3.01 GENERAL INSTALLATION**

- A. Coordinate location of disconnect and starter or motor controller. Combination starter/disconnects may be used in lieu of separate items.
- B. Explosion-Proof Motors: UL approved and labeled for hazard classification, with over temperature protection.
- C. Provide inverter ready motors per NEMA MG1-30 for variable speed drive or soft-start starter use. Provide shaft grounding for motors over 2 HP serving variable speed drives. Provide shaft grounding and insulated bearings on motors 25 HP and larger serving variable speed drives. Shielded cable required for power wiring from variable speed drive to motor connection.
- D. Unless otherwise indicated, motors 1-HP and larger to meet/exceed NEMA Premium Efficiency.

- E. Vertical in-line pump motors per NEMA MG1 vertical motor requirements.
- F. Exception: Motors less than 250 watts, for intermittent service, motors furnished with equipment manufacturer's standard package equipment need not conform to these specifications.
- G. Motors located in exterior locations or wet air streams are to be of totally enclosed type.
- H. Disconnects: Provided by Division 26, Electrical unless specified otherwise.
- I. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

### **3.02 STARTER INSTALLATION**

- A. Install starters in accordance with manufacturer's instructions.
- B. Coordinate disconnect requirements and location with Division 26, Electrical if not integral to starter. If starter is installed out of line of sight of motor, provide additional disconnect at motor per code.
- C. Provide NEMA housing appropriate to installation location.
- D. Provide supports and install securely, in neat and workmanlike manner, as specified in NECA 1.
- E. Meet mounting height and accessible location requirements per local code.
- F. Provide fuses for fusible switches.
- G. Select and install overload heater elements in motor starters to match installed motor characteristics.
- H. Single Phase 120 Volt Starter: If not furnished as single packaged controller/disconnect, provide contactors, relays, wiring and devices necessary to match sequence of operation for equipment.

### **3.03 SHAFT GROUNDING INSTALLATION**

- A. Shaft grounding assembly installation not to affect the motor manufacturer warranty. Where the severe environment conditions require application of the shaft grounding types that are screwed into the motor shaft, the installation of the shaft grounding system performed either by the motor manufacturer or by the motor manufacturer authorized facility.
- B. Bond the brush to the closest ground point using code sized green insulated stranded copper conductor per manufacturer instructions.
- C. Test and verify the performance of the assembly to ensure that under no conditions the shaft exceeds 3 volts.
- D. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- E. Check line voltage and phase and ensure agreement with nameplate.
- F. Verify motor rotation.

**END OF SECTION**

**SECTION 230529  
HANGERS AND SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Hangers and Supports for HVAC Piping, Ductwork and Equipment
  - 2. Wall and Floor Sleeves
  - 3. Building Attachments
  - 4. Flashing
  - 5. Miscellaneous Metal and Materials

**1.02 RELATED SECTIONS**

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. ASCE 7-16, Minimum Design Loads for Buildings and Other Structures.
  - 2. Terminology: As defined in MSS SP-90 "Guidelines on Terminology for Pipe Hangers and Supports".
  - 3. Install ductwork and piping per SMACNA's requirements.
  - 4. Hanger spacing installation and attachment to meet all manufacturer's requirements and MSS SP-58.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Welding:
    - a. Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications".
  - 2. Welding for Hangers:
    - a. Qualify procedures and personnel according to AWS D9.1, Sheet Metal Welding Code for duct joint and seam welding.
  - 3. Engineering Responsibility:
    - a. Design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze, duct support equipment hangers/supports, support from floor structure, roof structure or from structure above, and seismic restraint by a qualified Structural Professional Engineer.
      - 1) Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design, and extent.
  - 4. Manufacturers regularly engaged in the manufacture of bolted metal framing support systems, whose products have been in satisfactory use in similar service for not less than



10 years.

5. Support systems to be supplied by a single manufacturer.

#### **1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

#### **1.07 PERFORMANCE REQUIREMENTS**

- A. Provide pipe, ductwork and equipment hangers and supports in accordance with the following:
  1. When supports, anchorages, and seismic restraints for equipment, and supports, anchorages, and seismic restraints for conduit, piping, and ductwork are not shown on the Drawings, the contractor is responsible for their design.
  2. Connections to structural framing not to introduce twisting, torsion, or lateral bending in the framing members. Provide supplementary steel as required.
- B. Engineered Support Systems:
  1. Support frames such as pipe racks or stanchions for piping, ductwork, and equipment which provide support from below.
  2. Equipment, ductwork and piping support frame anchorage to supporting slab or structure.
- C. Provide channel support systems, for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- D. Provide heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- E. Provide seismic restraint hangers and supports for piping, ductwork and equipment. See Section 23 05 48, Vibration and Seismic Controls for HVAC Equipment.
- F. Obtain approval from AHJ for seismic restraint hanger and support system to be installed for piping and equipment. See Section 23 05 48, Vibration and Seismic Controls for HVAC Equipment.

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Hangers and Supports for HVAC Piping, Ductwork and Equipment:
  1. Anvil International
  2. B-Line Systems, Incorporated
  3. Erico Company, Incorporated
  4. Nelson-Olsen Incorporated
  5. Rilco Manufacturing Company, Incorporated
  6. Snappitz Thermal Pipe Shield Manufacturing
  7. Unistrut Corporation
- B. Wall and Floor Sleeves:
  1. Thunderline Corporation "Link Seal".
  2. Or approved equivalent.
- C. Building Attachments:
  1. Anchor-It
  2. Gunnebo Fastening Corporation
  3. Hilti Corporation
  4. ITW Ramset/Red Head
  5. Masterset Fastening Systems, Incorporated

#### **2.02 HANGERS AND SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT**

- A. Hanger Rods: Hanger rods continuously threaded or threaded ends only in concealed spaces and threaded ends only in exposed spaces; finish electro-galvanized or cadmium-plated in concealed spaces and prime painted in exposed spaces; sizes per MSS.

- B. Hanger Rod Couplings: Anvil Figure 136, B-Line Figure B3220, or approved equivalent; malleable iron rod coupling with elongated center sight gap for visual inspection; to have same finish as hanger rods.
- C. Channel Hanging System:
  - 1. Framing members No. 12 gauge formed steel channels, 1-5/8-inch square, conforming to ASTM A1011 Grade 33, one side of channel to have a continuous slot within turned lips; framing nut with grooves and spring 1/2-inch size, conforming to ASTM 675 GR60; screws conforming to ASTM A307; fittings conforming to ASTM A575; parts enamel painted or electro-galvanized.
  - 2. Concrete Inserts: Malleable iron body, hot dipped galvanized finish. Lateral adjustment. MSS Type 18.
- D. Pipe Hangers:
  - 1. Pipe Rings for Hanger Rods:
    - a. Pipe Sizes 2-inches and Smaller: Adjustable swivel ring hanger, UL listed. Erico 100 or 101, Anvil Figures 69 or 104, or approved equivalent.
    - b. Pipe hangers to have same finish as hanger rods.
- E. Pipe Saddles and Shields:
  - 1. Factory fabricated saddles or shields under piping hangers and supports for insulated piping.
  - 2. Size saddles and shields for exact fit to mate with pipe insulation. 1/2 round, 18 gauge, minimum 12-inches in length (4-inch pipe and larger to be three times longer than pipe diameter).
- F. Freestanding Roof Supports: Polyethylene high-density UV resistant quick "pipe" block with foam pad.

### 2.03 WALL AND FLOOR SLEEVES

- A. Pre-Engineered Firestop Pipe Penetration Systems: UL listed assemblies for maintaining fire rating of piping penetrations through fire-rated assemblies. Comply with ASTM E814.
- B. Fabricated Accessories:
  - 1. Steel Pipe Sleeves: Fabricate from Schedule 40 black or galvanized steel pipe. Remove end burrs by grinding.
  - 2. Sheet Metal Pipe Sleeves: Fabricate from G-90 galvanized sheets closed with lock-seam joints. Provide the following minimum gauges for the sizes indicated:
    - a. Sleeve Size 4-inches in Diameter and Smaller: 18 gauge.
    - b. Sleeve Sizes 5-6-inches: 16 gauge.
    - c. Sleeve Sizes 7-inches and Larger: 14 gauge.
    - d. Fire-Rated Safing Material.
      - 1) Rockwool Insulation: Complying with FS-HH-I-558, Form A, Class IV, 6 pounds per cubic foot density with melting point of 1985 degrees F and K value of 0.24 at 75 degrees F.
      - 2) Calcium Silicate Insulation: Noncombustible, complying with FS-HH-I-523, Type II, suitable for 100 degrees F to 1200 degrees F service with K value of 0.40 at 150 degrees F.

### 2.04 BUILDING ATTACHMENTS

- A. Beam Clamps:
  - 1. MSS Type 19 and 23, wide throat, with retaining clip.
  - 2. Universal Side Beam Clamp: MSS Type 20.
- B. Anchor Bolts:
  - 1. Anchor supports to existing masonry, block and tile walls per anchoring system manufacturer's recommendations or as modified by project structural engineer. Insert-type attachments with pull-out and shear capacities appropriate for supported loads and

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- building materials where used.
2. Anchor Bolts (Cast-In-Place): Steel bolts, ASTM A307. Nuts to conform to ASTM A194. Design values for shear and tension not more than 80 percent of the allowable listed loads.
  3. Anchor (Expansion) Bolts: Carbon steel to ASTM A307; nut to conform to ASTM A194; drilled-in type. Design values for shear and tension not more than 80 percent of the allowable listed loads.
  4. Anchor (Adhesive) Bolts: Consisting of two-part adhesive cartridge and zinc-plated Type A307 steel anchor bolt rod assembly with ASTM A194 nut.

## 2.05 FLASHING

- A. Steel Flashing: 26 gauge galvanized steel.
- B. Safes: 8 mil thick neoprene.
- C. Caps: Steel, 22 gauge minimum, 16 gauge at fire-resistant structures.

## 2.06 MISCELLANEOUS METAL AND MATERIALS

- A. General:
  1. Provide miscellaneous supports and metal items, including materials, fabrication, fastenings and accessories required for finished installation, where indicated on drawings or otherwise not shown on drawings that are necessary for completion of the project. Contractor is responsible for their design.
  2. Fabricate miscellaneous units to size shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.
- B. Structural Shapes: Where miscellaneous metal items are needed to be fabricated from structural steel shapes and plates, provide members constructed of steel conforming with requirements of ASTM A36 or approved equivalent.
- C. Steel Pipe: Provide seamless steel pipe conforming to requirements of ASTM A53, Type S, Grade A, or Grade B. Weight and size required as specified.
- D. Fasteners: Provide fasteners of types as required for assembly and installation of fabricated items; surface-applied fasteners are specified elsewhere.
- E. Bolts: Low carbon steel externally and internally threaded fasteners conforming with requirements of ASTM A307; include necessary nuts and plain hardened washers. For structural steel elements supporting mechanical material or equipment from building structural members or connection thereto, use fasteners conforming to ASTM A325.
- F. Miscellaneous Materials: Provide incidental accessory materials, tools, methods, and equipment required for fabrication.
- G. Provide hot dipped galvanized components for items exposed to weather. Cold galvanize field-welded joints and components. Use materials compatible with system being supported (i.e. aluminum for aluminum ductwork, stainless steel for stainless steel ductwork).
- H. Use straps, threshold rods and wire with sizes required by SMACNA to support ductwork.
- I. Grout:
  1. ASTM C1107, Grade B, factory mixed and packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
  2. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
  3. Properties: Nonstaining, noncorrosive, and non gaseous.
  4. Design Mix: 5000-PSI (34.5-MPa), 28-day compressive strength.

### **PART 3 - EXECUTION**

#### **3.01 GENERAL INSTALLATION REQUIREMENTS**

- A. Verify building materials to have hangers and attachments affixed in accordance with hangers to be used. Provide supporting calculations.
- B. Examine Drawings and coordinate for verification of exact locations of fire and smoke rated walls, partitions, floors and other assemblies. Indicate, by shading and labeling on Record Drawings such locations and label as "1-Hour Wall", "2-Hour Fire/Smoke Barrier", and the like. Determine proper locations for piping penetrations. Set sleeves in place in new floors, walls or roofs prior to concrete pour or grouting.
- C. Install hangers, supports, anchors and sleeves after required building structural work has been completed in areas where the work is to be installed. Coordinate proper placement of inserts, anchors and other building structural attachments.
- D. Equipment Clearances: Do not route ductwork, equipment, or piping through electrical rooms, IT rooms, or other electrical or electronic equipment spaces and enclosures and the like. Within equipment rooms, provide minimum 3-foot lateral clearance from all sides of electric switchgear panels. Do not route ductwork, equipment, or piping above any electric power or lighting panel, switchgear, or similar electric device. Coordinate with Electrical and coordinate exact ductwork, equipment or pipe routing to provide proper clearance with such items.

#### **3.02 HANGERS AND SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT**

- A. Hang rectangular sheet-metal ducts with a cross sectional area of less than 7 SF with galvanized strips of No. 16 USS gauge steel 1-inch wide, and larger ducts with steel angles and adjustable hanger rods similar to piping hangers. Support at a maximum of 8-feet on center.
- B. Support horizontal ducts within 24-inches of each elbow and within 48-inches of each branch intersection.
- C. Design hangers and supports to allow for expansion and contraction.
- D. Provide aluminum supports for aluminum ductwork.
- E. Provide stainless steel supports for stainless steel ductwork.
- F. Support vertical ducts at maximum intervals of 16-feet and at each floor.
- G. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- H. Install flexible ductwork per the more stringent of SMACNA HVAC Duct Construction Standards or the following:
  - 1. Support horizontal duct runs at not more than 4 feet intervals.
  - 2. Support vertical risers at not more than 6 feet intervals.
  - 3. Limit sag between support hangers to 1/2-inch per foot of spacing support.
  - 4. Supports shall be rigid and shall be not less than 1.5-inches wide at point of contact with the duct surface.
  - 5. Duct bends shall be not less than 1.5 duct diameter bend radius.
- I. Use double nuts and lock washers on threaded rod supports.
- J. Floor supports in mechanical rooms to be elevated 1-inch above finish floor and void space filled with masonry grout.
- K. Anchor ducts securely to building in such a manner as to prevent transmission of vibration to structure. Do not connect duct hanger straps directly to roof deck. Do not support ducts from other ducts, piping or equipment.
- L. Attach strap hangers installed flush with end of sheet-metal duct run to duct with sheet-metal screws.

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- M. Construct exterior ductwork or ductwork which is otherwise exposed to weather watertight and slope 1/4-inch per foot to avoid standing water.
- N. Exposed ductwork hung in clean areas such as sanitary areas, pharmaceutical areas, wash down areas or food process areas to be installed using double end, food grade trapeze hanger rods suitable for use with food grade strut.
- O. Channel Support System Installation:
  - 1. Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
  - 2. Field assemble and install according to manufacturer's written instructions.
- P. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- Q. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- R. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- S. Adjust hangers so as to distribute loads equally on attachments. Provide grout under supports to bring piping, ductwork and equipment to proper level and elevations.
- T. Prime paint ferrous nongalvanized hangers, accessories, and supplementary steel which are not factory painted.
- U. Horizontal Piping Hangers and Supports; Horizontal and Vertical Piping, and Hanger Rod Attachments:
  - 1. Factory fabricated horizontal piping hangers and supports complying with MSS SP-58, to suit piping systems and in accordance with manufacturer's published product information.
  - 2. Use only one type by one manufacturer for each piping service.
  - 3. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping.
  - 4. Pipe support spacing (pipe supported in ceiling or floor-supported) to meet latest applicable Code and manufacturer's requirements.
  - 5. Provide copper-plated hangers and supports for uninsulated copper piping systems.
- V. Plumber's Tape not permitted as pipe hangers or pipe straps.
- W. Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure. For horizontally hung grooved-end piping, provide a minimum of 2 hangers per pipe section.
- X. Pipe Ring Diameters:
  - 1. Uninsulated and Insulated Pipe, Except Where Oversized Pipe Rings are Specified: Ring inner diameter to suit pipe outer diameter.
  - 2. Insulated Piping Where Oversized Pipe Rings are Specified and Vibration Isolating Sleeves: Ring inner diameter to suit outer diameter of insulation or sleeve.
- Y. Oversize Pipe Rings: Provide oversize pipe rings of 2-inch and larger size.
- Z. Pipe Support Brackets: Support pipe with pipe slides.
- AA. Steel Backing in Walls: Provide steel backing in walls to support fixtures and piping hung from steel stud walls.
- BB. Group parallel runs of horizontal piping to be supported together on trapeze-type hangers. Maximum spacings: MSS SP-58.
- CC. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe.

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- DD. Do not support piping from other piping.
- EE. Fire protection piping will be supported independently of other piping.
- FF. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated.
- GG. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping" is not exceeded.
- HH. Insulated Piping:
1. Attach clamps and spacers to piping.
    - a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating Below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
  2. Do not exceed pipe stress limits according to ASME B31.9.
  3. Install MSS SP-58, Type 39 protection saddles, if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
  4. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields to span arc of 180 degrees.
  5. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN100) and larger if pipe is installed on rollers.
  6. Shield Dimensions for Pipe, not less than the following:
    - a. NPS 1/4 to NPS 3-1/2 (DN8 to DN 90): 12-inches long and 0.048-inch thick.
    - b. NPS 4 (DN100): 12-inches long and 0.06-inch thick.
    - c. NPS 5 and NPS 6 (DN125 and DN150): 18-inches long and 0.06-inch thick.
    - d. NPS 8 to NPS 14 (DN200 to DN350): 24-inches long and 0.075-inch thick.
    - e. NPS 16 to NPS 24 (DN400 to DN600): 24-inches long and 0.105-inch thick.
  7. Pipes NPS 8 (DN200) and Larger: Include wood inserts.
    - a. Insert Material: Length at least as long as protective shield.
  8. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
- II. Pipe Anchors: Provide anchors to fasten piping which is subject to expansion and contraction, and adjacent to equipment to prevent loading high forces onto the equipment.
- JJ. Pipe Curb Assemblies:
1. Provide prefabricated units for roof membrane and insulation penetrations related to equipment. Coordinate with roofing system. Set supports on the structural deck. Do not set supports on insulation or roofing. Provide level supports by prefabricated pitch built into the curb.
  2. Provide for piping and electrical conduit which penetrates the structural roof deck to service equipment above the roof level (i.e., piping, electrical power and control wiring). Meet requirements of roof warranty.
- KK. Escutcheon Plates: Install around horizontal and vertical piping at visible penetrations through walls, partitions, floors, or ceilings, including penetrations through closets, through below ceiling corridor walls, and through equipment room walls and floors.
- LL. Vertical Piping:
1. Support with U-clamps fastened to wall to hold piping away from wall unless otherwise approved.
- MM. Piping Above Roof:
1. Provide engineered roof piping supports appropriate for installation and attachment to the roof structure or structure below roof (see Architectural and Structural Drawings for roof construction, building structural systems, and sloping requirements for insulation).
  2. Design a complete system unless specific details have been shown on Drawings.

3. Provide calculations signed and stamped by a Structural Engineer, registered in the State where the project is located at, as part of submittals and coordinated shop drawings.
4. Do not use freestanding supports unless approved by the Structural Engineer of Record.
5. Provide miscellaneous metal and materials as specified in Miscellaneous Metal and Materials article, above.

### **3.03 WALL AND FLOOR SLEEVES**

- A. Fabricated Pipe Sleeves:
  1. Provide either steel or sheet metal pipe sleeves accurately centered around pipe routes. Size such that piping and insulation, if any, will have free movement within the sleeve, including allowance for thermal expansion. Sleeve diameter to be determined by local seismic clearance requirements, and by waterproofing requirements.
  2. Length: Equal to thickness of construction penetrated, except extend floor sleeves 1-inch above floor finish.
  3. Provide temporary support of sleeves during placement in concrete and other work around sleeves. Provide temporary end closures to prevent concrete and other materials from entering pipe sleeves.
  4. Seal each end airtight with a resilient nonhardening sealer, UL listed, fire rated ASTM 814.
- B. Installation of metallic or plastic piping penetrations through non fire-rated walls and partitions and through smoke-rated walls and partitions:
  1. Install fabricated pipe sleeve.
  2. After installation of sleeve and piping, tightly pack entire annular void between piping or piping insulation and sleeve identification with specified material.
  3. Seal each end airtight with a resilient nonhardening UL listed fire resistant ASTM 814.
- C. Piping Penetrations Through Fire-Rated (One to Three Hour) Assemblies:
  1. Select and install pre-engineered pipe penetration system in accordance with the UL listing and manufacturer's recommendation.
  2. Provide proper sizing when providing sleeves or core-drilled holes to accommodate the penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet the requirements of ASTM E814.

### **3.04 BUILDING ATTACHMENTS**

- A. Factory fabricated attachments complying with MSS SP-58, selected to suit building substructure conditions and in accordance manufacturer's published product information.
- B. Select size of building attachments to suit hanger rods.
- C. Space attachments within maximum piping span length indicated in MSS SP-58.
- D. Install building attachments within concrete slabs or attach to structural steel or wood. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping.
- E. Attachment to Wood Structure: Anvil side beam bracket Figure 202 for attachment to wooden beam or approved attachment for a wood structure.
- F. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- G. Install concrete inserts before concrete is placed; fasten inserts to forms. Where concrete with compressive strength less than 2500 PSI is indicated, install reinforcing bars through openings at top in inserts.
- H. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Test powder-actuated insert attachments with a minimum load of 100 pounds.

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- I. Do not use powder-actuated concrete fasteners for lightweight aggregate concretes or for slabs less than 4-inches thick.
- J. Bolting: Provide bored, drilled or reamed holes for bolting to miscellaneous structural metals, frames or for mounts or supports. Flame cut, punched or hand sawn holes will not be accepted.
- K. Anchor Bolts:
  - 1. Install anchor bolts for mechanical equipment, piping and ductwork as required. Tightly fit and clamp base-supported equipment anchor bolts at equipment support points. Provide locknuts where equipment, piping and ductwork are hung.
  - 2. Anchor Bolts (Cast-In-Place): Embed anchor bolts in new cast-in-place concrete to anchor equipment. Install a pipe sleeve around the anchor bolt for adjustment of the top 1/3 of the bolt embedment; sizes and patterns to suit the installation conditions of the equipment to be anchored.

### 3.05 FLASHING

- A. Flash and counterflash where piping, ductwork and equipment passes through weather or waterproofed walls, floors, and roofs.
- B. Provide 12-inch minimum height curbs for roof-mounted mechanical equipment. Flash and counter flash with galvanized steel, soldered and waterproofed.

### 3.06 MISCELLANEOUS METAL AND MATERIALS

- A. General: Verify dimensions prior to fabrication. Form metal items to accurate sizes and configurations as indicated on drawings and otherwise required for proper installation; make with lines straight and angles sharp, clean and true; drill, countersink, tap, and otherwise prepare items for connections with work of other trades, as required. Fabricate to detail of structural shapes, plates and bars; weld joints where practicable; provide bolts and other connection devices required. Include anchorages; clip angles, sleeves, anchor plates, and similar devices. Hot dipped galvanize after fabrication items installed in exterior locations. Set accurately in position as required and anchor securely to building construction. Construct items with joints formed for strength and rigidity, accurately machining for proper fit; where exposed to weather, form to exclude water.
- B. Finishes:
  - 1. Ferrous Metal: After fabrication, but before erection, clean surfaces by mechanical or chemical methods to remove rust, scale, oil, corrosion, or other substances detrimental to bonding of subsequently applied protective coatings. For metal items exposed to weather or moisture, galvanize in manner to obtain G90 zinc coating in accordance with ASTM A123. Provide other non-galvanized ferrous metal with 1 coat of approved rust-resisting paint primer, in manner to obtain not less than 1.0 mil dry film thickness. Touch-up damaged areas in primer with same material, before installation. Apply zinc coatings and paint primers uniformly and smoothly; leave ready for finish painting as specified elsewhere.
  - 2. Metal in Contact with Concrete, Masonry and Other Dissimilar Materials: Where metal items are to be erected in contact with dissimilar materials, provide contact surfaces with coating of an approved zinc-chromate primer in manner to obtain not less than 1.0 mil dry film thickness, in addition to other coatings specified in these specifications.
  - 3. For Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A780.
- C. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including, threaded



fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required. Avoid cutting concrete reinforcing when drilling for inserts. Reference structural drawings and reinforcing shop drawings and determine locations of stirrups prior to drilling into concrete.

- E. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items, which are to be built into concrete masonry or similar construction.
- F. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.
- G. Setting Loose Plates: Clean concrete and masonry bearing surfaces of any bond reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.
- H. Set loose leveling and bearing plates on wedges, or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut-off flush with edge of the bearing plate before packing with grout. Use metallic non-shrink grout in concealed locations where not exposed to moisture; use non-metallic non-shrink grout in exposed locations, unless otherwise indicated.
- I. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.
- J. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.
- K. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
- L. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.
- M. Provide galvanized components for items exposed to weather.

### **3.07 FIRE RATED SUPPORTS**

- A. Provide fire rated support as required by Codes.

**END OF SECTION**

**SECTION 230548**  
**VIBRATION AND SEISMIC CONTROLS FOR HVAC EQUIPMENT**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Vibration Isolation
  - 2. Seismic Restraint Devices
  - 3. Factory Finishes
  - 4. Seismic-Bracing/Restraint Devices/Systems for Equipment, Piping and Ductwork
- B. General:
  - 1. Vibration isolation for mechanical ductwork, piping and equipment.
  - 2. Seismic restraint for mechanical ductwork, piping and equipment.
  - 3. Seismic Certification for equipment, hangers and systems.
  - 4. Special inspections for systems.
- C. Scope of Work:
  - 1. Vibration isolation and seismic restraint of new equipment and systems within project boundary defined in architectural drawings.
  - 2. Vibration isolation and seismic restraint of new equipment and systems in existing buildings to points of connection with existing systems.
  - 3. Seismic restraint of existing systems and equipment shown on Drawings, within project boundary defined in architectural drawings.
  - 4. Provide supplementary structural steel for seismic restraint systems. No hanging from roof deck is permitted on this project, unless specifically allowed by Structural Engineer of Record in writing prior to bid.

**1.02 RELATED SECTIONS**

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Vibration Isolation:
    - a. Product Data: Provide catalog data indicating size, type, load and deflection of each isolator; and percent of vibration transmitted based on lowest disturbing frequency of equipment.
    - b. Shop Drawings: Showing complete details of construction for steel and concrete bases including:
      - 1) Fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment and cantilever loads.
      - 2) Equipment mounting holes.
      - 3) Dimensions.
      - 4) Size and location of concrete and steel bases and curbs.
      - 5) Isolation selected for each support point.
      - 6) Details of mounting brackets for isolator.
      - 7) Weight distribution for each isolator.

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- 8) Details of seismic snubbers.
- 9) Code number assigned to each isolator.
- c. Design calculations: Provide calculations for selecting vibration isolators and for designing vibration isolation bases.
2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
3. Seismic Restraint:
  - a. Shop Drawings: Show compliance with requirements of Quality Assurance article of this Section. Shop drawings to be stamped by a professional Structural Engineer licensed in State of Oregon.
  - b. Calculations: Submit seismic calculations indicating restraint loadings resulting from design seismic forces. Include anchorage details and indicate quantity, diameter and depth of penetration of anchors. Calculations certified by professional Structural Engineer licensed in State of Oregon.
4. Seismic Restraint Details: Detail fabrication and attachment of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter and depth of penetration of anchors.
5. Submittals for Interlocking Snubbers: Include load deflection curves up to 1/2-inch deflection in x, y and z planes.
6. Welding certificates.
7. Equipment Certification: Provide seismic certification for equipment as noted in Seismic Design Summary or schedules on Drawings.

#### 1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  1. Vibration Isolation:
    - a. Except for packaged equipment with integral isolators, single manufacturer selects and furnishes isolation required.
    - b. Deflections indicated on drawings are minimum actual static deflections for specific equipment supported.
    - c. Isolator Stability:
      - 1) Size springs of sufficient diameter to maintain stability of equipment being supported. Spring diameters not less than 0.8 of compressed height at rated load.
      - 2) Springs have minimum additional travel to solid equal to 50 percent of rated deflection.
      - 3) Springs support 200 percent of rated load, fully compressed, without deformation or failure.
    - d. Maximum Allowable Vibration Levels: Peak vibration velocities not exceed 0.08 in/sec. Correct equipment operating at vibration velocities that exceed this criteria.
  2. Seismic Restraint:
    - a. Code and Standard Requirements:
      - 1) Seismic restraint of equipment, piping and ductwork to be in accordance with latest enacted version of ASCE 7-16 and OSSC Chapter 16.
    - b. Confirm Seismic Control requirements in Division 01, General Requirements and Structural documents.
    - c. Certification: See Seismic Design Table or schedules on Drawings for equipment, systems and seismic-restraint devices designated to have seismic certification/qualification. Horizontal and vertical load testing and analysis performed

according to ASCE 7-16. Anchorage systems to bear anchorage preapproval number from an agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing or calculations, if preapproved ratings are not available. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be sealed by qualified licensed professional engineer in State of Oregon. Testing and calculations must include both shear and tensile loads and one test or analysis at 45 degrees to weakest mode.

- d. Seismic restraint and anchorage of permanent equipment and associated systems listed below to building structure be designed to resist total design seismic force prescribed in local building code:
    - 1) Floor- or roof-mounted equipment weighing 400 pounds or greater.
    - 2) Suspended, wall-mounted or vibration isolated equipment weighing 20 pounds or greater.
    - 3) In-line duct devices connected to ductwork weighing 75 pounds or greater.
    - 4) Housekeeping slabs: provide reinforcement and anchorage to building structure.
  - e. Where required, seismic sway bracing of suspended duct and piping meet following:
    - 1) Pipe and duct runs requiring seismic bracing have minimum of two traverse braces and one longitudinal brace. Longitudinal (or traverse) brace at 90 degree change in direction may act as traverse (or longitudinal) brace if located within 2-feet of change in direction.
    - 2) Seismic bracing may not pass through seismic separation joint. Pipe or duct runs that pass through seismic separation joint must be restrained within 5-feet of both sides of separation.
    - 3) Seismic brace assembly spacing not to exceed 40-feet transverse and 80-feet longitudinal.
  - f. Seismic restraints may be omitted from suspended piping and duct if following conditions are satisfied:
    - 1) For piping or ducts supported by rod hangers 12-inches or less in length from top of duct to bottom of structural support. Top connections to structure have swivel joints, eye bolts, or vibration isolation hangers for entire length of system run.
    - 2) Lateral motion of system will not cause damaging impact with surrounding systems or cause loss of system vertical support.
    - 3) System must be welded steel pipe, brazed copper pipe, sheet metal duct or similar ductile material with ductile connections.
- C. Seismic restraints, including anchors to building structure, be designed by registered professional Structural Engineer licensed in State of Oregon. Design includes:
1. Number, size, capacity and location of anchors for floor- or roof-mounted equipment. For curb-mounted equipment, provide design of attachment of both unit to curb and curb to structure.
  2. Number, size, capacity and location of seismic restraint devices and anchors for vibration-isolation and suspended equipment. Provide calculations and test data verifying horizontal and vertical ratings of seismic restraint devices.
  3. Number, size, capacity and location of braces and anchors for suspended piping and ductwork on as-built plan drawings.
  4. Maximum seismic loads to be indicated on drawings at each brace location. Drawings bear stamp and signature of registered professional Structural Engineer who designed layout of braces.

#### **1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

### 1.07 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Seismic Snubber Units: Furnish replacement neoprene inserts for snubbers.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Vibration Isolation:
  - 1. The VMC Group
  - 2. B-Line Systems, Inc.
  - 3. Kinetics Noise Control, Inc.
  - 4. Mason Industries, Inc.
  - 5. M.W. Saussé - Vibrex
  - 6. Where Mason numbers are specified, equivalent products by listed manufacturers are acceptable.
- B. Seismic Restraint Devices:
  - 1. The VMC Group
  - 2. B-Line Systems, Inc.
  - 3. Kinetics Noise Control, Inc.
  - 4. Mason Industries, Inc.
  - 5. M.W. Saussé - Vibrex
  - 6. California Dynamics Corporation
  - 7. Cooper B-Line Tolco
  - 8. Unistrut Diversified Products Co.; Wayne Manufacturing Division.
  - 9. Hilti, Inc.
- C. Factory Finishes:
  - 1. Kynar 500 Fluoropolymer Coating
  - 2. Or approved equivalent.
- D. Seismic-Bracing/Restraint Devices/Systems for Equipment, Piping and Ductwork:
  - 1. The VMC Group
  - 2. Kinetics Noise Control, Inc.
  - 3. Mason Industries, Inc.
  - 4. Hilti, Inc.
  - 5. Cooper B-Line, Inc.
  - 6. California Dynamics Corporation
  - 7. Unistrut
  - 8. ISAT, Inc.
  - 9. Where Mason numbers are specified, equivalent products by listed manufacturers are acceptable.

### 2.02 VIBRATION ISOLATION

- A. Type 1 - Neoprene Pad: Natural rubber waffle pads, arranged in single or multiple layers, 3/4-inch thick per layer with pattern repeating on 1/2-inch centers; 50 durometer hardness; maximum loading 60 PSI. Minimum 1/4-inch thick steel load distribution plate and 1/16-inch shim plates between layers, factory cut to sizes matching requirements of supported equipment. Molded bridge with neoprene anchor bolt bushing and flat washer face to prevent metal to metal contact. Number of layers required for equipment scheduled. Mason Type: Super WMH.
- B. Type 2 - Neoprene Mount: Double-deflection type, with ductile-iron housing containing two separate and opposing, oil-resistant natural rubber or bridge bearing neoprene elements, factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to

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structure. Neoprene elements to prevent metal to metal contact during normal operation. Minimum static deflection of 0.30-inches. Mason Type: BR.

- C. Type 3 - Spring: Freestanding, laterally stable, open-spring isolators.
  - 1. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.
  - 2. Minimum Additional Travel: 50 percent of required deflection at rated load.
  - 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  - 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, natural rubber or bridge bearing neoprene isolator pad attached to baseplate underside. Baseplates limit floor load to 100 PSIG (690 kPa).
  - 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
  - 7. Brackets: Manufacturer's standard bracket, utilize height saving brackets to accommodate height restrictions.
  - 8. Mason Type: SLFH or SLF.
- D. Type 4a - Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
  - 1. Housing: Steel with resilient vertical-limit stops (out of contact during normal operation) to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch thick, natural rubber or bridge bearing neoprene isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation. Restraining bolts have large rubber grommets to provide cushioning in vertical and horizontal directions. A minimum clearance of 3/8-inch maintained around restraining bolts so as not to interfere with spring action.
  - 2. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.
  - 3. Minimum Additional Travel: 50 percent of required deflection at rated load.
  - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  - 6. Brackets: Manufacturer's standard bracket, utilize height saving brackets to accommodate height restrictions.
  - 7. Mason Type: SLR.
- E. Type 4b - Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
  - 1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint with neoprene acoustical cup, spring inspection ports and rebound adjustment ports.
  - 2. Base: Factory drilled for bolting to structure.
  - 3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel before contacting a resilient collar.
  - 4. Brackets: Manufacturer's standard bracket, utilize height saving brackets to accommodate height restrictions.
  - 5. Mason Type: SSLFH.
- F. Type 5a - Restrained Elastomeric Hangers: Double-deflection type, with molded, oil-resistant natural rubber or bridge bearing neoprene isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range. Seismic rebound steel and bonded LDS rubber washer to limit upward seismic movement. Mason Type: RWHD.
- G. Type 5b - Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

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1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 15 degrees of angular hanger-rod misalignment from vertical without binding or reducing isolation efficiency.
  2. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.
  3. Minimum Additional Travel: 50 percent of required deflection at rated load.
  4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
  7. Mason Type: 30N.
- H. Type 5c - Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 15 degrees of angular hanger-rod misalignment from vertical without binding or reducing isolation efficiency.
  2. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.
  3. Minimum Additional Travel: 50 percent of required deflection at rated load.
  4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
  7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
  8. Mason Type: RW30.
- I. Type 6 - Horizontal Thrust Restraints: Combination coil spring and elastomeric insert with spring and insert in compression and with a load stop. Include rod and angle-iron brackets for attaching to equipment.
1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
  2. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.
  3. Minimum Additional Travel: 50 percent of required deflection at rated load.
  4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
  7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.
  8. Mason Type: WBI or WBD.
- J. Type 8 - Resilient Pipe Vertical Sliding Guide: Telescopic arrangement of 2 steel tubes separated by a minimum of 1/2-inch thick, 60-durometer neoprene. Factory set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction. Shear pin be removable and reinsertable to allow for selection of pipe movement. Guides be capable of motion to meet location requirements. Mason Type: VSG. Provide pipe expansion hangers to control load shifts as the riser expands or contracts, Mason HES.
- K. Type FC-1, Flexible duct connectors. See Specification Section 23 33 00 Air Duct Accessories.
- L. Type FC-2A, Flexible Pipe Connector, Steel:
1. 321 stainless steel, close pitch, annular corrugated hose.

2. Exterior Sleeve: 304 stainless steel, braided.
  3. Pressure Rating: 125 PSI at 70 degrees F for 12-inch and smaller pipe.
  4. Joint: ANSI Class 150 carbon steel flanges.
  5. Size: Use pipe sized units.
  6. Minimum Allowable Offset: 3/4-inch on each side of installed center line.
  7. Basis of Design: Metraflex Model MLP.
- M. Type FC-2B, Flexible Pipe Connector, Copper:
1. Inner Hose: Bronze, close pitch, annular corrugated hose.
  2. Exterior Sleeve: Braided bronze (for piping over 2-inches, to be 3 pound braided stainless steel).
  3. Minimum Allowable Pressure Rating: 125 PSI at 70 degrees F.
  4. Joint: Sweat ends.
  5. Size: Use pipe sized units.
  6. Minimum Allowable Offset: 3/8-inch on each side of installed center line.
  7. Basis of Design: Metraflex Model BBS.
- N. Type FC-3, Flexible Compensator, Double Sphere:
1. Body: Molded twin spherical type. Neoprene with internal cord or wire.
  2. Minimum Pressure Rating, Sizes 2-inch to 12-inch: 225 PSI at 170 degrees F.
  3. Minimum Pressure Rating, Sizes 14-inch to 20-inch: 125 PSI at 170 degrees F.
  4. Minimum Allowable Compression: 1-1/2 inches.
  5. Minimum Allowable Elongation: 1-1/8 inches.
  6. Minimum Allowable Offset: 1-1/8 inches.
  7. Minimum Allowable Angular Movement: 20 degrees.
  8. Joint: Steel flanges.
  9. Accessories: Galvanized aircraft-type cable or control rods to prevent over extension.
  10. Basis of Design: Metraflex Doublesphere.

### 2.03 SEISMIC RESTRAINT DEVICES

- A. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5, with a flat washer face.
- B. Seismic Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts and replaceable resilient isolation washers and bushings. Snubber load rating to match equipment size. Mason Type: Z-1011 or Z-1225.
1. Anchor bolts for attaching to concrete be seismic-rated, drill-in and stud-wedge or female-wedge type.
  2. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5.
- C. Restraining Cables: Galvanized steel aircraft cables with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement. Mason Type: SCB.
- D. Anchor Bolts: Seismic-rated, drill-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488/E 488M.

### 2.04 FACTORY FINISHES

- A. Provide manufacturer's standard prime-coat finish ready for field painting. Units mounted outdoors exposed to weather: Epoxy powder coated, with 1000 hour salt spray rating per ASTM B-117. For high levels of corrosion protection utilize:
1. Conform to AAMA 605.2.
  2. Apply coating following cleaning and pretreatment.
  3. Cleaning: AA-C12C42R1X.
  4. Dry system before final finish application.



5. Total Dry Film Thickness: Approximately 1.2 mils, when baked at 450 degrees F for 10 minutes.
- B. Finish:
1. Manufacturer's standard paint applied to factory-assembled and factory-tested equipment before shipping.
  2. Powder coating on springs and housings.
  3. Hardware be electrogalvanized. Hot-dip galvanize metal components for exterior use.
  4. Baked enamel for metal components on isolators for interior use.
  5. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

## **2.05 SEISMIC-BRACING/RESTRAINT DEVICES/SYSTEMS FOR EQUIPMENT, PIPING AND DUCTWORK**

- A. General Requirements for Restraint Components: Rated strengths, features and applications to be as defined in reports by agency acceptable to authorities having jurisdiction.
- B. Structural Safety Factor: Allowable strength in tension, shear and pullout force of components be at least four times maximum seismic forces to which they will be subjected.
- C. Anchor bolts for attaching to concrete to be seismic-rated, drill-in and stud-wedge or female-wedge type.
- D. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
- E. Maximum 1/4-inch air gap and minimum 1/4-inch thick resilient cushion.

## **PART 3 - EXECUTION**

### **3.01 GENERAL INSTALLATION REQUIREMENTS**

- A. Provide mounts for equipment installed outdoors for wind loads of 30 lbs. psf applied to any exposed surface of isolated equipment.
- B. Do not install equipment or pipe which makes rigid contact with building slabs, beams, studs, walls, etc.
- C. Anchor baseplate to floor or structure. Provide rubber grommets and washers to isolate bolt from base plate. Under no circumstances is isolation efficiency to be destroyed when bolting isolators to floor.
- D. Building Penetrations: Isolate water piping and ductwork penetrating wall, ceilings, floors or shafts from structure by piping isolator or by 3/8-inch thick foamed rubber insulation. Install units flush with finished structure face, using one for each side as required. Cut units to length if longer than structure thickness. Caulk around pipe or duct at equipment room wall.
- E. Provide roof curbs, equipment supports and roof penetrations. Work to maintain roof warranty. Coordinate location, size, structural connections/requirements and flashing prior to installation.
- F. Install Type 6 horizontal thrust restraints at centerline of thrust, symmetrical on either side of equipment.
- G. Vibration isolators must not cause change of position of equipment or piping which would stress piping connections or misalignment shafts or bearings. Isolated equipment is to be level and in proper alignment with connecting ducts and pipes.
- H. Pipe Hangers in Equipment Rooms: Support water and gas piping connected to rotating equipment within equipment rooms on spring and neoprene hangers. The first three hangers from a piece of vibrating equipment are to have a minimum of 1/2 static deflection of equipment isolators. Other isolators should have a minimum of 1/4 static deflection of equipment isolators.
- I. Examination:
  1. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements, installation tolerances and other conditions affecting performance.

2. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
  3. Proceed with installation only after unsatisfactory conditions have been corrected.
- J. Testing: Perform following field quality-control testing:
1. Isolator seismic-restraint clearance.
  2. Isolator deflection.
  3. Snubber minimum clearances.
- K. Adjusting:
1. Adjust snubbers according to manufacturer's written recommendations.
  2. Torque anchor bolts according to equipment manufacturer's written recommendations to resist seismic forces.
- L. Cleaning: After completing equipment installation, inspect vibration isolation and seismic-control devices. Remove paint splatters and other spots, dirt and debris.
- M. Demonstration: Engage factory-authorized service representative to train Owner's maintenance personnel to adjust, operate and maintain air-mounting systems. Reference Division 01, General Requirements.

**3.02 VIBRATION ISOLATION**

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Vibration isolators must be installed in strict accordance with manufacturer's written instructions and certified submittal data.
- D. Install isolation as indicated on drawings by type and location and where indicated below.
- E. Equipment Vibration Isolation Schedule:

<b>Equipment</b>	<b>Size</b>	<b>Vibration Isolator Type</b>	<b>Minimum Deflection (in)</b>
Condensing Units	0 to 4.5 tons	Type 1 or 2	0.3
Rooftop Air Handlers, AC, Heat Pump Units	0 to 19.5 tons	FC-1,2	0.75

- F. Isolation Mounts:
1. Install minimum of four seismic snubbers on isolated equipment. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
  2. Install resilient bolt isolation washers on equipment anchor bolts.
  3. Provide flexible piping connection and flexible ductwork connection to equipment with isolation mounts or bases.
- G. Isolating Hangers:
1. Support piping and ductwork connected to isolated equipment within equipment rooms on isolating hangers as scheduled on drawings. Unless otherwise noted, first three hangers from isolated equipment to have a minimum of 1/2 static deflection of equipment isolators. Other isolating hangers to have a minimum of 1/4 static deflection of equipment isolators.
  2. Position isolating hanger elements as high as possible in hanger rod assembly, but not in contact with building structure. Install hangers so that hanger housing may rotate full 360 degrees about rod axis without contacting any object.
  3. Unless otherwise noted, air supply units with internally isolated fans do not require isolating hangers for connecting pipes and ductwork.

4. Where parallel running pipes are hung together on an isolated trapeze, provide isolator deflections for largest determined by provisions for pipe isolation. Do not mix isolated and non-isolated pipes in same trapeze.
  5. Install limit stops so they are out of contact during normal operation.
- H. Adjusting:
1. Adjust isolators after piping systems have been filled and equipment is at operating weight.
  2. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
  3. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop.

### **3.03 SEISMIC RESTRAINT DEVICES**

- A. Reference 3.01, General Installation Requirements.
- B. Install in strict accordance with manufacturer's written instructions and certified submittal data.
- C. Install and adjust seismic restraints so equipment, piping and ductwork supports are not degraded by restraints.
- D. Restraints must not short circuit vibration isolation systems or transmit objectionable vibration or noise.
- E. Install restraining cables at each trapeze, individual pipe hanger and hanging vibration isolated equipment. Provide restraining cables in each of the four directions of movement. Install restraining cables no less than 45 Degrees from vertical. At trapeze anchor locations, shackle piping to trapeze. Install cables so they do not bend across sharp edges of adjacent equipment or building structure.
- F. Install steel angles or channel, sized to prevent buckling, clamped with ductile-iron clamps to hanger rods for trapeze and individual pipe hangers. At trapeze anchor locations, shackle piping to trapeze. Requirements apply equally to hanging equipment. Do not weld angles to rods.

### **3.04 FACTORY FINISHES**

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Finishes to be factory-applied. No field patching or holidays allowed.

### **3.05 SEISMIC-BRACING/RESTRAINT DEVICES/SYSTEMS FOR EQUIPMENT, PIPING AND DUCTWORK**

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.

**END OF SECTION**

**SECTION 230553**  
**IDENTIFICATION FOR HVAC PIPING, DUCTWORK AND EQUIPMENT**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Plastic Nameplates
  - 2. Tags
  - 3. Plastic Pipe Markers
  - 4. Ceiling Tags

**1.02 RELATED SECTIONS**

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Schedules:
    - a. Submit valve schedule for each piping system, in tabular format using Microsoft Word or Excel software. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shutoff and similar special uses by special "flags" in margin of schedule. In addition to mounted copies, furnish extra copies for maintenance manuals.
  - 2. Submit schedule of identification type, including material, for each class of tagged item.
  - 3. Submit locations at which Valve Schedules will be installed.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Manufacturer's Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required.
  - 2. Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices unless otherwise indicated.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

**PART 2 - PRODUCTS**

**2.01 PLASTIC NAMEPLATES**

- A. Manufacturers:
  - 1. Brady Corporation
  - 2. Brimar
  - 3. Champion America
  - 4. Craftmark
  - 5. Seton
  - 6. Or approved equivalent.

- B. Description: Engraving stock melamine plastic laminate in the size and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color), punched for mechanical fastening except where adhesive mounting is necessary because of substrate. Provide 1/8-inch thick material.
1. Letter Color: White.
  2. Letter Height: 1/2-inch.
  3. Background Color: Black.
  4. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
  5. Access Panel Markers: Manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve or devices/equipment. Include center hole to allow attachment.

## 2.02 TAGS

- A. Manufacturers:
1. Brady Corporation
  2. Brimar
  3. Champion America
  4. Craftmark
  5. Seton
  6. Or approved equivalent.
- B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 2-inch diameter.
- C. Metal Tags: Polished Brass with stamped letters; tag size minimum 2-inch diameter with smooth edges.
- D. Valve designations to be coordinated with existing valve identifications to ensure no repetitive designations are utilized.
- E. Chart/Schedules: Valve Schedule Frames. For each page of a valve schedule, provide glazed display frame with removable mounting as appropriate for wall construction upon which frame is to be mounted. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.
- F. Valve Tag Fasteners: Solid brass chain (wire link or beaded type), or solid brass S-hooks.
- G. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
1. Size: Approximately 4 by 7-inches.
  2. Fasteners: Brass grommet and wire.
  3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
  4. Color: Yellow background with black lettering.

## 2.03 PLASTIC PIPE MARKERS

- A. Manufacturers:
1. Brady Corporation
  2. Brimar
  3. Champion America
  4. Craftmark
  5. Seton
  6. Or approved equivalent.
- B. Color: Conform to ASME A13.1 and ANSI Z535.1.
- C. Plastic Pipe Markers (for external diameters of 6-inches and larger including insulation): Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum

information indicating flow direction arrow and identification of fluid being conveyed.

- D. Plastic Tape Pipe Markers (for external diameters less than 6-inches including insulation): Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings. Minimum information indicating flow direction arrow and identification of fluid being conveyed.
- E. Lettering:
  - 1. 3/4-inch to 1-1/4-inch Outside Diameter of Insulation or Pipe: 8-inch long color field, 1/2-inch high letters.
  - 2. 1-1/2-inch to 2-inch Outside Diameter of Insulation or Pipe: 8-inch long color field, 3/4-inch high letters.
  - 3. 2-1/2-inch to 6-inch Outside Diameter of Insulation or Pipe: 12-inch long color field, 1-1/4-inch high letters.
  - 4. 8-inch to 10-inch Outside Diameter of Insulation or Pipe: 24-inch long color field, 2-1/2-inch high letters.
  - 5. Over 10-inch Outside Diameter of Insulation or Pipe: 32-inch long color field, 3-1/2-inch high letters.

#### **2.04 CEILING TAGS**

- A. Manufacturers:
  - 1. Brady Corporation
  - 2. Brimar
  - 3. Champion America
  - 4. Craftmark
  - 5. Seton
  - 6. Or approved equivalent.
- B. Description: Steel with 3/4-inch diameter color coded head.
- C. Color code as follows:
  - 1. Yellow - HVAC equipment.
  - 2. Red - Fire dampers/smoke dampers.
  - 3. Blue - Heating/cooling valves.
  - 4. Ceiling tile labels, machine generated, adhesive backed tape labels with black letters, clear tape.

### **PART 3 - EXECUTION**

#### **3.01 GENERAL - INSTALLATION**

- A. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates riveted to equipment body.
- B. Identify piping, concealed or exposed, with plastic pipe markers.
- C. Coordinate names, abbreviations and other designations used in mechanical identification work with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.
- D. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples: Chiller No. 3, Air Handling Unit No. 42, Standpipe F12, and the like).
- E. Degrease and clean surfaces to receive adhesive for identification materials.
- F. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

- G. Coordinate with the facility maintenance personnel to ensure consistency with the existing tagging system.
- H. Install all products in accordance with manufacturer's instructions.
- I. Manual Balancing Dampers: Provide 12-inch long orange marker ribbon to end of balancing damper handle.

### **3.02 PLASTIC NAMEPLATES**

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners.
- B. Identify control panels and major control components outside panels with plastic nameplates riveted to equipment body.
- C. Identify thermostats with nameplates.

### **3.03 TAGS**

- A. Use metal tags on piping 3/4-inch diameter and smaller.
- B. Tag balancing valves and major dampers with balanced GPM or CFM indicated after balancing is completed and accepted.
- C. Install tags with corrosion resistant chain.
- D. Small devices, such as in-line pumps, may be identified with tags.
- E. Identify valves with metal tags. Indicate valve function and the normally open or closed positions on the valve tag.
- F. Identify air terminal units and radiator valves with numbered plastic tags.
- G. Tag automatic controls, instruments, and relays. Key to control schematic.
- H. Install valve schedule at each mechanical room.

### **3.04 PLASTIC PIPE MARKERS**

- A. Install plastic pipe markers complete around pipe in accordance with manufacturer's instructions.
- B. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20-feet (reduced to 10-feet in congested areas and mechanical equipment rooms) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction. Locate near branches, valves, control devices, equipment connections, access doors, floor/wall penetrations.

### **3.05 CEILING TAGS**

- A. Provide ceiling tags to locate valves, dampers, and equipment above accessible ceilings. Locate in corner of ceiling tee grid closest to equipment.

**END OF SECTION**

**SECTION 230593**  
**TESTING, ADJUSTING, AND BALANCING FOR HVAC**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. General Requirements and Procedures
  - 2. Fundamental Air Systems Balancing Procedures
  - 3. Temperature Control Verification
  - 4. Constant Volume Air Systems Balancing Procedures
  - 5. Pre-Balance Reporting
  - 6. Final Reports:
    - a. Report Requirements
    - b. General Report Data
    - c. System Diagrams
    - d. Air Handling Units
    - e. Fans
    - f. Duct Traverses
    - g. Diffusers/Registers/Grilles
    - h. Instrument Calibration
  - 7. Additional Tests

**1.02 RELATED SECTIONS**

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Quality-Assurance Submittals: Submit two copies of evidence that the Testing, Adjusting, and Balancing (TAB) Agent and Project's TAB team members meet the qualifications specified in the "Quality Assurance" Article below.
  - 2. Pre-Construction Phase Report:
    - a. Provide a pre-construction phase TAB Plan at least two weeks prior to the commencement of TAB work. This report is to include:
      - 1) A complete set of report forms intended for use on the Project, with data filled in except for the field readings. Forms to be Project-specific.
      - 2) Marked up shop drawings identifying all HVAC equipment to be balanced, and associated outlets and terminal devices.
      - 3) Identification of the type, manufacturer, and model of the actual instruments to be used, and clear indication of which instrument will be used to take each type of reading. Calibration certifications to be included.
      - 4) A narrative of Project-specific and/or non-standard TAB procedures to be used, and the equipment or systems to which they apply.
  - 3. Contract Documents Examination Report: Within 45 days from the Contractor's Notice to Proceed, submit two copies of the Contract Documents review report as specified in Part 3 of this Section.
  - 4. Strategies and Procedures Plan: Submit two copies of the TAB strategies and step-by-step procedures as specified in Part 3 of this Section. Include a complete set of report



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- forms intended for use on this Project.
5. Specify reports required because of editing procedures in Part 3 of this Section.
  6. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by the TAB Agent.
  7. Sample Report Forms: Submit two sets of sample TAB report forms.
  8. Test Instrument Calibration: Submit proof of calibration within the last 6 months.
  9. Final Report.
  10. Provide additional submittals to commissioning authority as dictated in Commissioning Specifications.

#### 1.05 QUALITY ASSURANCE

- A. Quality Assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  1. Acceptable TAB Agencies:
    - a. Oregon:
      - 1) Air Introduction and Regulations Inc.
      - 2) Accurate Air Balance, Inc.
      - 3) Neudorfer Engineers
      - 4) Northwest Engineering Services
      - 5) Air Balancing Specialty Inc.
      - 6) Precision Test & Balance, Inc.
      - 7) Testcomm
      - 8) American Commissioning and LEED Consultants, Inc.
    2. Balance Firm Qualifications:
      - a. General:
        - 1) Procure services of independent TAB agency to balance, adjust and test water circulating and air moving equipment and air distribution or exhaust systems. Minimum experience: 5 years.
        - 2) Provide proof of testing agency having successfully completed at least five projects of similar size and scope.
      - b. Testing and Balancing firm is certified by NEBB or AABC and has a NEBB Certified Professional (CP) or a AABC Test and Balancer Engineer (TBE) on staff.
      - c. Industry Standards: Testing and Balancing will conform to NEBB or AABC, and American National Standards Institute (ANSI) as follows:
        - 1) NEBB: Comply with Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
        - 2) AABC: Comply with National Standards for Total System Balance.
        - 3) ANSI:
          - (a) S1.4 Specifications for sound level meters.
          - (b) S1.11 Specifications for Octave-Band and Fractional-Octave-Band analog and digital filters.
          - (c) ANSI S1.13 Methods for the Measurement of Sound Pressure Levels.
      - d. Test Observation: If requested, conduct tests in the presence of the Commissioning Authority, AHJ, Architect or the Architect's representative.
    3. Code Compliance: Perform tests in the presence of the Authority Having Jurisdiction (AHJ) where required by the Authority Having Jurisdiction (AHJ).
    4. Owner Witness: Perform tests in the presence of the Commissioning Authority, Architect, Architect's Representative, or Owner's representative.
    5. Engineer Witness: The engineer or engineer's representative reserves the right to observe tests or selected tests to assure compliance with the specifications.
    6. Simultaneous Testing: Test observations by the AHJ, the Owner's Authorized Representative and the engineer's representative need not occur simultaneously.

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7. Do not perform TAB work until heating, ventilating, and air conditioning equipment has been completely installed and is operating continuously as required.
8. Conduct air testing and balancing with clean filters in place. Clean strainers prior to performing hydronic testing and balancing.
9. TAB Conference: Meet with the Commissioning Authority, Owner's and the Architect's representatives on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel. Provide 7 days advance notice of scheduled meeting time and location.
  - a. Agenda Items: Include at least the following:
    - 1) Submittal distribution requirements.
    - 2) Contract Documents examination report.
    - 3) TAB plan.
    - 4) Work schedule and Project site access requirements.
    - 5) Coordination and cooperation of trades and subcontractors.
    - 6) Coordination of documentation and communication flow.
10. Certification of TAB Reports: This certification includes the following:
  - a. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
  - b. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
11. TAB Reports: Use standard forms from NEBB or AABC.
12. Instrumentation Type, Quantity, and Accuracy: As described in NEBB or AABC.
13. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

#### 1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  1. TAB Agency provides warranty for a period of 90 days following submission of completed report, during which time, Owner may request a recheck of up to 10 percent of total number of terminals, or resetting of outlet, coil, or device listed in the final TAB report.
  2. Guarantee: Meet the requirements of the following programs:
    - a. Provide a guarantee on NEBB or AABC forms stating that the agency will assist in completing the requirements of the Contract Documents if the TAB Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:
      - 1) The certified Agent has tested, adjusted, and balanced systems according to the Contract Documents.
      - 2) Systems are balanced to optimum performance capabilities within design and installation limits.

#### 1.07 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.
- C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

- E. Report Forms: Test data sheets for recording test data in logical order.
- F. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- G. TAB: Testing, Adjusting, and Balancing.
- H. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- I. Test: A procedure to determine quantitative performance of a system or equipment.
- J. Testing, Adjusting, and Balancing (TAB) Agent: The entity responsible for performing and reporting the TAB procedures.
- K. AABC: Associated Air Balance Council.
- L. NEBB: National Environmental Balancing Bureau.
- M. AMCA: Air Movement and Control Association.
- N. CTI: Cooling Tower Institute.
- O. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

#### **1.08 COORDINATION**

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Notice: Provide 7 days advance notice for each test. Include scheduled test dates and times.
- C. Witness leakage and pressure tests carried out by Section 23 31 00, HVAC Ducts and Casings.
- D. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

#### **PART 2 - PRODUCTS - NOT USED**

#### **PART 3 - EXECUTION**

##### **3.01 GENERAL REQUIREMENTS AND PROCEDURES**

- A. Project Conditions:
  - 1. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during TAB operations to minimize conflicts with the Owner's operations.
- B. General Requirements:
  - 1. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and controls, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
  - 2. Perform TAB work with doors, closed windows, and ceilings installed etc., to obtain simulated or project operating conditions. Do not proceed until systems scheduled for TAB are clean and free from debris, dirt and discarded building materials.
  - 3. Where Owner occupies building during the testing period, cooperate with Owner to minimize conflicts with Owner's operations.
- C. Examination:
  - 1. Examine Contract Documents to become familiar with project requirements and existing building record documents (if available) to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
    - a. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
    - b. Verify that balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are

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required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

2. Examine approved submittal data of HVAC systems and equipment.
  3. Examine Project record documents described in Division 01, General Requirements.
  4. Examine Architect's and Engineer's design data, including Basis of Design, HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
  5. Examine equipment performance data, including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
  6. Coordinate requirements in system and equipment with this Section.
  7. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
  8. Examine system and equipment test reports.
  9. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
  10. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
  11. Examine equipment for installation and for properly operating safety interlocks and controls.
  12. Report deficiencies discovered before and during performance of TAB procedures.
- D. Preparation:
1. Prepare a TAB plan that includes strategies and step-by-step procedures.
  2. Complete system readiness checks and prepare system readiness reports. Verify the following:
    - a. Permanent electrical power wiring is complete.
    - b. Hydronic systems are filled, clean, and free of air.
    - c. Automatic temperature-control systems are operational.
    - d. Equipment and duct access doors are securely closed.
    - e. Balance, smoke, and fire dampers are open.
    - f. Isolating and balancing valves are open and control valves are operational.
    - g. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
    - h. Windows, doors and other portions of the building envelope can be closed so design conditions for system operations can be met.
  3. Hold a pre-balancing meeting at least one week prior to starting TAB work.
    - a. Attendance is required by installers whose work will be tested, adjusted, or balanced.
  4. Provide instruments required for TAB operations. Make instruments available to Architect to facilitate spot checks during testing.
- E. General TAB Procedures:

1. Perform TAB procedures on each system according to the procedures contained in NEBB or AABC and this Section.
  2. Coordinate location of test probes prior to start of TAB procedures and make test probes available for Owner's tests after start of occupancy. Where required, cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
  3. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- F. Adjustment Tolerances:
1. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 5 percent of design for return and exhaust systems.
  2. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
  3. Hydronic Systems: Adjust to within plus or minus 10 percent of design at coils and plus or minus 5 percent at system pumps and equipment.
  4. Adjust supply, return, and exhaust air quantities to maintain pressurization in spaces indicated on Drawings. Note and document room-to-room pressurization and maintain these relationships. Adjust pressure controlled spaces to within plus or minus 0.01 in WC.
- G. Recording and Adjusting:
1. Field Logs: Maintain written logs including:
    - a. Running log of events and issues.
    - b. Discrepancies, deficient or uncompleted work by others.
    - c. Contract interpretation requests.
    - d. Lists of completed tests.
  2. Ensure recorded data represents actual measured or observed conditions.
  3. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
  4. Mark on drawings locations where traverse and other critical measurements were taken and cross reference location in final report.
  5. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
  6. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
  7. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner's Authorized Representative, or Commissioning Agent.

### **3.02 FUNDAMENTAL AIR SYSTEMS BALANCING PROCEDURES**

- A. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- B. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.
- C. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- D. Prepare test reports for both fans and inlets and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross check the summation of required outlet volumes with required fan volumes.
- E. Prepare schematic diagrams of systems' "as-built" duct layouts.

- F. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- G. Check the airflow patterns from the outside-air louvers and dampers and the return-air and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- H. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- I. Verify that motor starters are equipped with thermal protection, sized for the connected load.
- J. Check dampers for proper position to achieve desired airflow path.
- K. Check for airflow blockages.
- L. Check that condensate drains are installed, trapped and primed and routed to drain.
- M. Check for readily observable leaks in air-handling unit components and ductwork.
- N. Use sheaves and pulleys to adjust the speed of belt drive fans to achieve design flow with motors running at 60 Hertz unless noted otherwise.

### **3.03 TEMPERATURE CONTROL VERIFICATION**

- A. Examine automatic temperature system components to verify the following:
  - 1. Dampers, valves, and other controlled devices operate by the intended controller.
  - 2. Dampers and valves are in the position indicated by the controller.
  - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
  - 4. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.
  - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, equipment, drafts, and cold walls.
  - 6. Sensors are located to sense only the intended conditions.
  - 7. Sequence of operation for control modes is according to the Contract Documents.
  - 8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
  - 9. Interlocked systems are operating.
  - 10. Changeover from heating to cooling mode occurs according to design values.
- B. Verify that controllers are calibrated and commissioned.
- C. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- D. Record controller settings and note variances between set points and actual measurements.
- E. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).
- F. Verify free travel and proper operation of control devices such as damper and valve operators.
- G. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.
- H. Confirm interaction of electrically operated switch transducers.
- I. Confirm interaction of interlock and lockout systems.
- J. Verify main control supply-air pressure and observe compressor and dryer operations.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

### **3.04 CONSTANT VOLUME AIR SYSTEMS BALANCING PROCEDURES**

- A. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer. Adjust fans to deliver design airflow at the lowest possible speed.
  - 1. Measure fan static pressures to determine actual static pressure as follows:

- a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
  - b. Measure static pressure directly at the fan outlet or through the flexible connection.
  - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
  - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
2. Measure static pressure across each air-handling unit component under final balanced condition.
  3. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Recommend corrective action to align design and actual conditions.
  4. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
  5. Do not make fan-speed adjustments that result in motor loading greater than full load amps. Do not increase fan speed beyond fan class rating. Modulate dampers and measure fan-motor amperage to ensure no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.
  6. Adjust volume dampers for main duct, submain ducts, and major branch ducts to design airflows within specified tolerances.
  7. Calibrate airflow measuring stations.

### **3.05 PRE-BALANCE REPORTING**

- A. Pre-Construction Phase Report:
  1. Provide a pre-construction phase TAB Plan at least 2 weeks prior to the commencement of TAB work. This report is to include:
    - a. A complete set of report forms intended for use on the Project, with all data filled in except for the field readings. Forms to be Project-specific.
    - b. Marked up shop drawings identifying all HVAC equipment to be balanced, and associated outlets and terminal devices.
    - c. Identification of the type, manufacturer, and model of actual instruments to be used, and clear indication of which instrument will be used to take each type of reading. Calibration certifications are to be included.
    - d. A narrative of Project-specific and/or non-standard TAB procedures to be used, and the equipment or systems they apply to.
- B. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article above, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- C. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced.

### **3.06 FINAL REPORTS**

- A. Report Requirements:
  1. General:
    - a. Computer generated in PDF format and tabulated, divided, and bookmarked into sections by tested and balanced systems.
    - b. Include a certification sheet in front of binder signed and sealed by the certified TAB engineer.

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- 1) Include a list of the instruments used for procedures, along with proof of calibration.
- c. Final Report Contents: In addition to the certified field report data, include the following:
  - 1) Pump curves
  - 2) Fan Curves
  - 3) Manufacturers Test Data
  - 4) Field test reports prepared by system and equipment installers
  - 5) Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data
- B. General Report Data:
  1. In addition to the form titles and entries, include the following data in the final report, as applicable:
    - a. Title Page
    - b. Name and Address of TAB Agent
    - c. Project Name
    - d. Project Location
    - e. Architect's Name and Address
    - f. Engineer's Name and Address
    - g. Contractor's Name and Address
    - h. Report Date
    - i. Signature of TAB Agent who Certifies the Report
    - j. Summary of Contents, Including the Following:
      - 1) Design versus Final Performance
      - 2) Notable Characteristics of Systems
      - 3) Description of System Operation Sequence if it varies from the Contract Documents
    - k. Nomenclature Sheets for Each Item of Equipment
    - l. Data for Terminal Units, including Manufacturer, Type Size, and Fittings
    - m. Notes to explain why certain final data in the body of reports vary from design values.
    - n. Test Conditions for Fans and Pump Performance Forms, Including the Following:
      - 1) Settings for Outside-, Return-, and Exhaust-air Dampers
      - 2) Conditions of Filters
      - 3) Cooling Coil, Wet- and Dry-bulb Conditions
      - 4) Face and Bypass Damper Settings at Coils
      - 5) Fan Drive Settings, including Settings and Percentage of Maximum Pitch Diameter
      - 6) Inlet Vane Settings for Variable-Air-Volume Systems
      - 7) Settings for Supply-air, Static-pressure Controller
      - 8) Other System Operating Conditions that affect Performance
- C. System Diagrams:
  1. Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:
    - a. Quantities of Outside, Supply, Return, and Exhaust Airflows
    - b. Water and Steam Flow Rates
    - c. Duct, Outlet, and Inlet Sizes
    - d. Pipe and Valve Sizes and Locations
    - e. Terminal Units
    - f. Balancing Stations
- D. Air Handling Units:



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1. For air-handling units, split systems, fan coils, pumps, and evaporator units with coils, include the following:
  - a. Unit Data: Include the following:
    - 1) Unit Identification
    - 2) Location
    - 3) Make and Type
    - 4) Model Number and Unit Size
    - 5) Manufacturer's Serial Number
    - 6) Unit Arrangement and Class
    - 7) Discharge Arrangement
    - 8) Sheave Make, Size in inches, and Bore
    - 9) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches
    - 10) Number of Belts, Make, and Size
    - 11) Number of Filters, Type, and Size
  - b. Motor Data: Include the following:
    - 1) Make and Frame Type and Size
    - 2) Horsepower and rpm
    - 3) Volts, Phase, and Hertz
    - 4) Full-load Amperage and Service Factor
    - 5) Sheave Make, Size in Inches, and Bore
    - 6) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches
  - c. Test Data: Include design and actual values for the following:
    - 1) Total Airflow Rate in cfm (L/s)
    - 2) Total System Static Pressure in Inches wg (Pa)
    - 3) Fan rpm
    - 4) Discharge Static Pressure in Inches wg (Pa)
    - 5) Filter Static-pressure Differential in Inches wg (Pa)
    - 6) Preheat Coil Static-pressure Differential in Inches wg (Pa)
    - 7) Cooling Coil Static-pressure Differential in Inches wg (Pa)
    - 8) Heating Coil Static-pressure Differential in Inches wg (Pa)
    - 9) Outside Airflow in cfm (L/s)
    - 10) Return Airflow in cfm (L/s)
    - 11) Outside-air Damper Position
    - 12) Return-air Damper Position
    - 13) Vortex Damper Position

E. Fans:

1. Fan Test Reports: For supply, return, and exhaust fans, include the following:
  - a. Fan Data: Include the following:
    - 1) System Identification
    - 2) Location
    - 3) Make and Type
    - 4) Model Number and Size
    - 5) Manufacturer's Serial Number
    - 6) Arrangement and Class
    - 7) Sheave Make, Size in Inches, and Bore
    - 8) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches
  - b. Motor Data: Include the following:
    - 1) Make and Frame Type and Size
    - 2) Horsepower and rpm
    - 3) Volts, Phase, and Hertz
    - 4) Full-load Amperage and Service Factor

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- 5) Sheave Make, Size in Inches, and Bore
- 6) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches
- 7) Number of Belts, Make, and Size
- c. Test Data: Include design and actual values for the following:
  - 1) Total Airflow Rate in cfm
  - 2) Total System Static Pressure in Inches wg
  - 3) Fan rpm
  - 4) Discharge Static Pressure in Inches wg
  - 5) Suction Static Pressure in Inches wg
- F. Duct Traverses:
  1. Include a diagram with a grid representing the duct cross-section and record the following:
    - a. Report Data: Include the following:
      - 1) System and Air-handling Unit Number
      - 2) Location and Zone
      - 3) Duct Static Pressure in Inches wg
      - 4) Duct Size in Inches
      - 5) Duct Area in SF
      - 6) Design Airflow Rate in cfm
      - 7) Design Velocity in fpm
      - 8) Actual Airflow Rate in cfm
      - 9) Actual Average Velocity in fpm
- G. Diffusers/Registers/Grilles:
  1. For diffusers, registers and grilles, include the following:
    - a. Unit Data: Include the following:
      - 1) System and Air-handling Unit Identification
      - 2) Location and Zone
      - 3) Test Apparatus Used
      - 4) Area Served
      - 5) Air-terminal-device Make
      - 6) Air-terminal-device Number from System Diagram
      - 7) Air-terminal-device Type and Model Number
      - 8) Air-terminal-device Size
      - 9) Air-terminal-device Effective Area in SF
    - b. Test Data: Include design and actual values for the following:
      - 1) Airflow Rate in cfm
      - 2) Air Velocity in fpm
      - 3) Final Airflow Rate in cfm
      - 4) Final Velocity in fpm
      - 5) Space Temperature in Degrees F
- H. Instrument Calibration:
  1. For instrument calibration, include the following:
    - a. Report Data: Include the following:
      - 1) Instrument Type and Make
      - 2) Serial Number
      - 3) Application
      - 4) Dates of Use
    - b. Dates of Calibration

**3.07 ADDITIONAL TESTS**

- A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

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- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

**END OF SECTION**

**SECTION 230700  
HVAC INSULATION**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Type A, Flexible Glass Wool Blanket
  - 2. Type B, Duct Liner
  - 3. Type 2, Flexible Elastomeric Pipe Insulation
  - 4. Jacketing
  - 5. Accessories
  - 6. Duct Insulation Accessories
  - 7. Duct Insulation Compounds
  - 8. Outdoor Ducting Cover

**1.02 RELATED SECTIONS**

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Piping and duct insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Installer qualifications.
  - 2. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any) for each type of product indicated.
  - 3. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets with requirements indicated. Include dates of tests.
  - 4. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.
  - 5. Submit manufacturer's installation instructions.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Formaldehyde Free: Should be third-party certified with UL Environment Validation.
  - 2. Recycled Content: A minimum of 40 percent post-consumer recycled glass content certified and UL validated.
  - 3. Low Emitting Materials: For all thermal and acoustical applications of Glass Mineral Wool Insulation products, provide materials complying with the testing and products requirements of UL GREENGUARD Gold Certification.
  - 4. Installer to have minimum 5 years' experience in the business of installing insulation.

## 1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

## 1.07 FIRE HAZARD CLASSIFICATION

- A. Maximum fire hazard classification of the composite insulation construction as installed to be not more than a Flame Spread Index (FSI) of 25 and Smoke Developed Index (SDI) of 50 as tested by current edition of ASTM E84 (NFPA 255) method.
- B. Test pipe insulation in accordance with the requirements of current edition of UL "Pipe and Equipment Coverings R5583 400 8.15".
- C. Test duct insulation in accordance with current edition of ASTM E84, UL 723, NFPA 255, NFPA 90A and NFPA 90B.

## PART 2 - PRODUCTS

### 2.01 TYPE A, FLEXIBLE GLASS WOOL BLANKET

- A. Acceptable Manufacturers:
  - 1. Certaineed
  - 2. Johns Manville
  - 3. Knauf
  - 4. Owens-Corning
  - 5. Or approved equivalent.
- B. ASTM C553, Type 1, Class B-2; flexible blanket.
- C. 'K' Value: 0.27 BTU\*in/(hr\*s°F) at 75 degrees F installed, maximum service temperature: 250 degrees F.
- D. Density: 0.75 pounds per cubic foot.
- E. DBDE-free. UL/E validated to be formaldehyde-free.
- F. Vapor Barrier Jacket: FSK aluminum foil reinforced with glass wool yarn and laminated to fire resistant Kraft, secured with UL listed pressure sensitive tape or outward clinched expanded staples and vapor barrier mastic as needed.

### 2.02 TYPE B, DUCT LINER

- A. Acceptable Manufacturers:
  - 1. Certaineed
  - 2. Johns Manville
  - 3. Knauf
  - 4. Owens-Corning
  - 5. Or approved equivalent.
- B. ASTM C1071; flexible blanket.
- C. 'K' Value: ASTM C518, 0.25 BTU\*in/(hr\*s°F) at 75 degrees F, maximum service temperature: 250 degrees F.
- D. Noise Reduction Coefficient: 0.65 or higher based on ASTM C 423 "Type A mounting."
- E. Maximum Velocity on Mat or Coated Air Side: 5,000 FPM.
- F. Adhesive: UL listed waterproof type.
- G. Fasteners: Duct liner galvanized steel pins, welded or mechanically fastened.
- H. Erosion-Resistant Surfaces: UL 181.
- I. ASTM G21 and ASTM G22 Microbial Growth Resistance.
- J. UL GREENGUARD Certified does not support the growth of mold, fungi, or bacteria per ASTM C 1338 and meets UL Environment GREENGUARD Microbial Resistance Listing per UL 2824-

“GREENGUARD Certification Program Method for Measuring Microbial Resistance”. DBDE-free. UL/E validated to be formaldehyde-free.

### **2.03 TYPE 2, FLEXIBLE ELASTOMERIC PIPE INSULATION**

- A. Acceptable Manufacturers:
  - 1. Insulation:
    - a. Armacell LLC Armaflex
    - b. K-Flex
    - c. Or approved equivalent.
  - 2. Glue:
    - a. Armacell LLC Armaflex Low VOC Adhesive
    - b. K-Flex
    - c. Or approved equivalent.
  - 3. Paint:
    - a. Armacell LLC Armaflex
    - b. K-Flex
    - c. Or approved equivalent.
- B. Elastomeric Foam: ASTM C534; flexible, cellular elastomeric, molded or sheet.
  - 1. Thermal Conductivity Value: As indicated in the insulation tables below.
  - 2. Maximum Service Temperature of 220 degrees F.
  - 3. Maximum Flame Spread: 25.
  - 4. Maximum Smoke Developed: 50 (1-inch thick and below).
  - 5. Vapor Retarder Jacket, for over 1-inch insulation thickness: White Kraft paper reinforced with glass wool and bonded to aluminum foil, secure with self-sealing longitudinal laps and butt strips or vapor barrier mastic.
  - 6. Connection: Waterproof vapor retarder adhesive as needed.
  - 7. UV Protection: UV outdoor protective coating per manufacturer's requirements.
- C. Glue: Contact adhesive specifically manufactured for cementing flexible elastomeric foam.
- D. Paint (for exterior insulation only): Nonhardening high elasticity type, specifically manufactured as protective covering of flexible elastomeric foam insulation for prevention of degradation due to exposure to sunlight and weather.

### **2.04 JACKETING**

- A. Acceptable Manufacturers:
  - 1. ITW Insulation Systems
  - 2. General Insulation Company
  - 3. 3M
  - 4. Or approved equivalent.
- B. Insulation Jacketing and Insulation Jacketing Tape for Ductwork and Piping: 0.024-inch thick multi-layered laminate with tensile strength of 187 lb/inch, puncture resistance of 68 pounds per ASTM D1000, emittance of 0.03 per ASTM C1371, WVTR of 0.00 perm per ASTM E96, and service temperature of -94 degrees F to 248 degrees F, as manufactured by 3M, VentureClad1579GCW-E, or approved equivalent.
- C. PVC preformed molded insulation covers, for piping. Zeston or approved equivalent.
- D. Stainless Steel Jacket: Type 304 stainless steel, 0.010-inch, smooth finish.

### **2.05 ACCESSORIES**

- A. Acceptable Manufacturers:
  - 1. ITW Insulation Systems
  - 2. Or approved equivalent.

- B. Equipment Insulation Jacketing: Presized glass cloth, not less than 7.8 ounces/sq.yd., except as otherwise indicated. Coat with gypsum based cement.
- C. Equipment Insulation Compounds: Provide adhesives, cement, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.
- D. General: Provide staples, bands, wire, wire netting, tape corner angles, anchors, stud pins and metal covers as recommended by insulation manufacturer for applications indicated. Accessories, i.e., adhesives, mastics, cements and tape to have the same flame and smoke component ratings as the insulation materials with which they are used. Shipping cartons to bear a label indicating that flame and smoke ratings do not exceed those listed above. Provide permanent treatment of jackets or facings to impart flame and smoke safety. Provide non-water-soluble treatments. Provide UV protection recommended by manufacturer for outdoor installation.

## **2.06 DUCT INSULATION ACCESSORIES**

- A. Acceptable Manufacturers:
  - 1. Certaineed
  - 2. Johns Manville
  - 3. Owens-Corning
  - 4. Or approved equivalent.
- B. Staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

## **2.07 DUCT INSULATION COMPOUNDS**

- A. Acceptable Manufacturers:
  - 1. Certaineed
  - 2. Johns Manville
  - 3. Owens-Corning
  - 4. Or approved equivalent.
- B. Cements, adhesives, coatings, sealers, protective finishes and similar accessories as recommended by insulation manufacturer for applications indicated. Comply with South Coast Air Quality Management District (SCAQMD) Rule #1168 in accordance with LLE EQ 4.1.

## **2.08 OUTDOOR DUCTING COVER**

- A. Acceptable Manufacturers:
  - 1. 3M
  - 2. Certaineed
  - 3. Johns Manville
  - 4. Owens-Corning
  - 5. Or approved equivalent.
- B. Aluminum Jacket: 0.024-inch thick multi-layered laminate with tensile strength of 187 lb/inch, puncture resistance of 68 pounds per ASTM D1000, emittance of 0.03 per ASTM C1371, WVTR of 0.00 perm per ASTM E96, and service temperature of -94 degrees F to 248 degrees F, as manufactured by 3M, VentureClad1579GCW-E, or approved equivalent, with longitudinal slip joints and 3-inch laps.
- C. UV resistant polyvinyl chloride covering with joints secured and sealed.

## **PART 3 - EXECUTION**

### **3.01 GENERAL INSTALLATION REQUIREMENTS**

- A. Verification of Conditions:
  - 1. Do not apply insulation until pressure testing and inspection of ducts and piping has been completed.

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2. Examine areas and conditions under which duct and pipe insulation will be installed. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Preparation: Clean and dry surfaces to be insulated.
- C. Installation:
  1. Insulation: Continuous through walls, floors and partitions except where noted otherwise.
  2. Piping and Equipment:
    - a. Install insulation over clean, dry surfaces with adjoining sections firmly butted together and covering surfaces. Fill voids and holes. Seal raw edges. Install insulation in a manner such that insulation may be split, removed, and reinstalled with vapor barrier tape on strainer caps and unions. Do not install insulation until piping has been leak tested and has passed such tests. Do not insulate manholes, equipment manufacturer's nameplates, handholes, and ASME stamps. Provide beveled edge at such insulation interruptions. Repair voids or tears.
    - b. Cover insulation on pipes above ground, outside of building, with aluminum jacketing. Position seam on bottom of pipe.
- D. Cover insulation on exposed refrigerant piping above ground, outside of building with heavy duty multi-layered laminated jacketing tape. Position seams on bottom of pipe. Use Venture Tape VentureClad Plus 1579GCW-E or approved equal.
- E. Provide accessories as required. See Part 2 Article "Accessories" above.
- F. Protection and Replacement: Installed insulation during construction. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- G. Labeling and Marking: Provide labels, arrows and color on piping and ductwork. Attach labels and flow direction arrows to the jacketing per Section 23 05 53, Identification for HVAC Piping, Ductwork and Equipment.
- H. Ductwork:
  1. Install insulation in conformance with manufacturer's recommendations to completely cover duct.
  2. Butt insulation joints firmly together and install jackets and tapes smoothly and securely.
  3. Apply duct insulation continuously through sleeves and prepared openings, except as otherwise specified. Apply vapor barrier materials to form complete unbroken vapor seal over insulation.
  4. Coat staples and seals with vapor barrier coating.
  5. Cover breaks in jacket materials with patches of same material as vapor barrier. Extend patches not less than 3-inches beyond break or penetration on all directions and secure with adhesive and staples. Seal staples and joints with vapor barrier coating.
  6. Fill jacket penetrations. i.e., hangers, thermometers and damper operating rods, and other voids in insulation with vapor barrier coating. Seal penetration with vapor barrier coating. Insulate hangers and supports for cold duct in un-conditioned spaces to extent to prevent condensation on surfaces.
  7. Seal and flash insulation terminations and pin punctures with reinforced vapor barrier coating.
  8. Continue insulation at fire dampers and fire/smoke dampers up to and including those portions of damper frame visible at outside of the rated fire barrier. Insulating terminations at fire dampers in accordance with this Section.
  9. Do not conceal duct access doors with insulation. Install insulation terminations at access door in accordance with this Section.
- I. Insulated Pipe Exposed to Weather: Where piping is exposed to weather, cover insulation with aluminum jacket. Seal watertight jacket per manufacturer's recommendations. Install metal jacket with 2-inch overlap at longitudinal and butt joints with exposed lap pointing down. Secure jacket with stainless-steel draw bands 12-inches on center and at butt joints.



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- J. Insulation Shields: Provide hangers and shields (18 gauge minimum) outside of insulation for cold piping (<60 degrees F). Hot water piping hangers may penetrate insulation to contact pipe directly. Provide 18-inch long, noncompressible insulation section at insulation shields for lines 2-inches and larger (hot and cold) piping.

- K. Ductwork Surfaces to be Insulated:

Item to be Insulated	System Insulation Type	Duct Size	Insulation Thickness
Supply ductwork where duct is not specified to be lined.	A	All	1.5-inch
Return ductwork where duct is not specified to be lined.	--	All	None
Supply ductwork (located outside building thermal envelope)	A (for round ductwork)	All	3-inch (for round ductwork)
Return ductwork (located outside building thermal envelope)	A (for round ductwork)	All	3-inch (for round ductwork)
Outside Air Ducts	A	All	3-inch
Combustion Air Ducts	A	All	3-inch
HVAC plenums and unit housings not preinsulated	B	All	1.5-inch
Exhaust ducts within 10-feet of exterior	A	All	3-inch

1. Note: Insulation thickness shown is a minimum. If state codes require additional thickness, then provide insulation thickness per code requirements.

- L. Piping Surfaces to be Insulated:

Item to be Insulated	System Insulation Type	Conductivity Range (Btu-inch per hour per SF per degrees F)	Pipe Size (Inches)	Insulation Thickness (Inches)
Refrigerant Suction and Liquid Piping (40F to 60F)	2	0.21-0.27 at a mean rating temperature of 75 degrees F	<1	0.5
			1 to <1.5	0.5
			1.5 to <4	1.0

			4 to <8	1.0
			>= 8	1.0
Refrigerant Suction and Liquid Piping (<=40F)	2	0.20-0.26 at a mean rating temperature of 50 degrees F	<1	0.5
			1 to <1.5	1.0
			1.5 to <4	1.0
			4 to <8	1.0
			>= 8	1.5

- Note: Insulation thickness shown is a minimum. If state code requires additional thickness, then provide insulation thickness per code requirements.

### 3.02 TYPE A, FLEXIBLE GLASS WOOL BLANKET

- Install insulation in conformance with manufacturer's recommendations and requirements.
- Duct Wrap: Cover air ducts per insulation table except ducts internally lined where internal duct lining is adequate to achieve adequate insulating values to meet local Energy Codes (indicate on shop drawings, locations where duct wrap is planned to be omitted and indicate internal duct lining insulating values to confirm they will meet the Energy Code.) Wrap tightly with circumferential joints butted and longitudinal joints overlapped minimum of 2-inches. On ducts over 24-inches wide, additionally secure insulation with suitable mechanical fasteners at 18-inches on center. Circumferential and longitudinal joints stapled with flare staples 6-inches on center and covered with 3-inch wide, foil reinforced tape.

### 3.03 TYPE B, DUCT LINER

- Install insulation in conformance with manufacturer's recommendations and requirements.
- Duct Liners: Mat finish surface on air stream side. Secure insulation to cleaned sheet metal duct with continuous (minimum 90) percent coat of adhesive. Secure liner with mechanical fasteners 15-inches on center or per manufacturer requirements. Accurately cut liner and thoroughly coat ends with adhesive. Butt joints tightly. Top and bottom sections of insulation overlap sides. Factory/field coat exposed edges. Metal nosing for exposed leading or transverse edges and when velocity exceeds 3500 FPM or manufacturer rating on exposed edges. Keep duct liner clean and free from dust. At completion of Project, vacuum duct liner if it is dirty or dusty. Do not use small pieces. If insulation is installed without horizontal, longitudinal, and end joints butted together, installation will be rejected and work removed and replaced with work that conforms to this Specification.

### 3.04 TYPE 2, FLEXIBLE ELASTOMERIC PIPE INSULATION

- Flexible Elastomeric Insulation:
  - Slip insulation on pipe prior to connection. Butt joints sealed with manufacturer's adhesive. Insulate fitting with miter-cut pieces. Cover insulation exposed to weather and below grade with two coats of finish as recommended by manufacturer.
- Flexible Elastomeric Tubing:
  - Flexible Elastomeric Tubing: Slip insulation over piping or, if piping is already installed, slit insulation and snap over piping. Joints and butt ends must be adhered with 520 adhesive.
- See General Installation Requirements above.
- Install insulation in conformance with manufacturer's recommendations and requirements.

- E. Slip insulation on pipe prior to connection. Butt joints sealed with manufacturer's adhesive. Insulate fitting with miter-cut pieces. Cover insulation exposed to weather and undergrade with two coats of finish as recommended by manufacturer.
- F. Install in accordance with manufacturer's instructions for below grade installation.

**3.05 JACKETING**

- A. See General Installation Requirements above.
- B. Install in accordance with manufacturer's instructions.

**3.06 ACCESSORIES**

- A. Install insulation in conformance with manufacturer's instructions, recommendations and requirements.
- B. See General Installation Requirements above.
- C. Furnish and install accessories for all insulation types listed in this Section.

**3.07 DUCT INSULATION ACCESSORIES**

- A. Install insulation in conformance with manufacturer's recommendations and requirements.

**3.08 DUCT INSULATION COMPOUNDS**

- A. Install insulation in conformance with manufacturer's recommendations and requirements.

**3.09 OUTDOOR DUCTING COVER**

- A. Install insulation in conformance with manufacturer's recommendations and requirements.
- B. Outdoor Duct Exposed to Weather:
  - 1. Install jacket with brakes/slope to prevent standing water on duct. Use weatherable components.
  - 2. Weatherproof seal at joints and seams. Minimum 3-inch overlap.
  - 3. Label jacket every 6-feet and within 2-feet of building penetrations and equipment connections: "Do not stand or place equipment on duct."

**END OF SECTION**

**SECTION 230800  
COMMISSIONING OF HVAC**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. Section includes Commissioning activities required for work of Division 23 Sections including but not limited to construction checks, equipment start-up, functional testing, and operator training.
- B. Comply with Section 01 91 13 – General Commissioning Requirements for Commissioning activities for Division 23 work.

**1.02 SEQUENCING**

- A. Provide written notification to Commissioning Provider (CxP) in advance of significant project dates as directed and as listed below.
  - 1. Two weeks prior to start-up of air handling units, air-conditioning units, and exhaust fans.
  - 2. Four weeks prior to installation of lay-in ceiling tiles or other partial concealment of equipment to be commissioned
  - 3. Four weeks prior to any system ready for balancing

**1.03 SUBMITTALS**

- A. Provide control system custom software, hardware, and technical manuals as necessary for development of Commissioning activities. Control system submittals include but are not limited to operating sequences, point database, workstation remote access, on-site custom programming/editing software, and programming and operations manual as necessary for development of Commissioning activities. Submit a minimum of 6 weeks prior to equipment start-up.
- B. Provide submittals of systems being commissioned to Owner's Authorized Representative as required by Section 01 91 13.
- C. Provide electronic copies (or hard copies where appropriate) of control system final configuration parameters, programs, databases, files, and electrical data as necessary to reconfigure and/or replace control components upon device failure.

**PART 2 - PRODUCTS**

**2.01 MATERIALS**

- A. Provide all necessary control hardware, software, and temporary licenses to enable Commissioning Provider to conduct activities and to fully access any electronic control systems furnished for this project. Commissioning Provider's laptop computer may be used for access if software and hardware systems provided are compatible with existing computer configuration, otherwise furnish laptop computer where required for duration of project.
- B. Provide minimum of two HVAC control operator interface sites for both on-site and remote access as described below:
  - 1. Commissioning Provider Access Functions: Review and modification of control programming, monitoring of control system operations, review and modification of software database, setup, and monitoring trend data in tabular and graphical formats.
  - 2. Remote Access: Remote access using Internet and shall include all functions described above.
  - 3. Provide credentials for Commissioning Provider. Security access level shall be suitable to perform necessary commissioning functions.
  - 4. Provide labor required to install hardware and software on personal computers at Commissioning Provider's office. Software will be manufacturer's most recent version and will be compatible with the CxP's personal computers. Provide Commissioning Provider with two hours training after fully functional remote access is established.

## **PART 3 - EXECUTION**

### **3.01 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Services: Manufacturer's Representative to execute Construction Checklists and perform operational training as specified in Division 23 including the following systems:
1. Boilers
  2. Chiller
  3. Packaged air handlers
  4. Laboratory exhaust fan
  5. Packaged rooftop air-conditioners
  6. Variable frequency drives
  7. Building Automation System

### **3.02 CONSTRUCTION CHECKLISTS**

- A. Contractor shall execute as required by Section 01 91 13. Construction Checklists for each system commissioned will be prepared by Commissioning Provider during construction.

### **3.03 CONTROL VERIFICATION REPORTS**

- A. Building Automation System: BAS control contractor shall perform verification of the function and performance of control hardware and software. Provide verification report demonstrating proper system installation and operation. Verification report shall include the following:
1. Network Communication: Verify that all network devices properly communicate on network. Verify communication speed and reliability is acceptable.
  2. Input and Output Verification:
    - a. Verify that all input and output points are indicating properly. Verification tests shall be "end-to-end," meaning field measurement to workstation graphic display value.
    - b. Calibrate all analog inputs. Acceptance accuracy shall be as specified for product accuracy. Repair or replace all devices that do not conform to specified accuracy.
    - c. Operate all analog outputs from 0% to 100% of operating range. Verify that controlled device operates over the entire output range and that maximum and minimum operating conditions are achieved.
    - d. Valves and dampers shall close fully and provide tight shutoff. Leakage rates shall not exceed specified values.
  3. Verify that all digital outputs operate controlled devices.
- B. Sequence of Operation Verification: Systematically verify automatic control sequence of operation functions in field after installation is complete. Verification shall include:
1. Time scheduling.
  2. Operating modes.
  3. Tune and adjust control loops and control sequences to optimize efficiency and performance. Control loops shall be stable and maintain desired setpoints.
- C. Trending: Confirm trending utilities storage of operating data as required to verify operation and performance of control modes, sequence, and loops. Meet with Owner and CxP to review configuration, parameter interval, and duration prior to trend setup.
- D. Operator Interface: Review function of operator interface. Confirm that graphic operator interface accurately depicts as-constructed system configuration and that all required content is displayed and functions as intended.
- E. Alarms: Confirm alarm utilities are configured as required, alarm conditions are displaying in alarm logs and on graphic displays, and provide annunciation and reporting as required. Meet with Owner and CxP to review configuration parameters prior to alarm utility setup.

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- F. Coordination: Assist balancing contractor with development of control setpoints and parameters as specifically indicated or otherwise required to provide Sequence of Operation. Setpoints would include but would not be limited to actuator positions required to provide minimum ventilation rates, supply air pressure setpoints for variable air volume air distribution systems, and terminal unit calibration parameters.
- G. Controls Verification Report: After system operation is completely verified, provide written certification to Owner that systems have been fully tested, are operating according to specifications, and ready for functional testing. Include documentation to the Commissioning Provider detailing verification results. Report shall include:
  - 1. Updated control construction drawings and equipment data that incorporates all changes made during construction.
  - 2. Printed or PDF of as-built control code.
  - 3. Printed or PDF of point data base.
  - 4. Input/Output Verification Log: Submit point verification log including point identification, applied.
  - 5. Sequence of Operation Verification: Submit verification test report listing complete text of control sequence and test results. Verify all specified control sequences.
  - 6. Trend Logs: Submit printed trend reports for the following:
    - a. Time schedules. Seven-day log demonstrating that equipment operates according to programmed time schedules.
    - b. Automatic control sequences. Trends shall be set-up as follows:
      - 1) Analog Control: Points that modulate over time shall be sampled at appropriate intervals and durations to demonstrate proper operating sequences. For example, a discharge temperature control loop would require trending during the morning warm-up mode and normal daytime operation mode. Each trend shall include all measured variables, control output signal, actual output signal, and controlled variable.
      - 2) Digital Control: Dual-state control or monitoring points shall be recorded as COV (+) or change of value meaning that the changed parameter only needs to be recorded after the value changes from its previous state. A minimum of one week of samples shall be provided to properly demonstrate equipment cycles, modes, and schedules.
  - 7. Include trend graphs as described below:
    - a. Lines shall be labeled and shall be distinguishable from each other by using either different line types, or different line colors.
    - b. Indicate engineering units of the y-axis values; e.g., degrees F., inches w.g., Btu/lb, percent wide open, etc.
    - c. The y-axis scale shall be chosen so that all trended values are in a readable range.
    - d. Do not mix trended values on one graph if their unit ranges are incompatible.
    - e. All points trended for one HVAC subsystem; e.g., air handling unit, chilled water system, etc. shall be trended during the same trend period.
    - f. Each graph shall be clearly labeled with HVAC subsystem title, date, and times.
  - 8. List of incomplete work.
- H. Demonstration: Demonstrate operation of control system to Engineer, Commissioning Provider, and Owner including:
  - 1. Menu functions.
  - 2. Point overrides.
  - 3. Control loop response after point modification.
  - 4. Alarm response time.

### **3.04 FUNCTIONAL TESTING**

- A. Contractor shall assist Commissioning Provider with functional testing as required by Section 01 91 13. Functional Test Plans for each system being commissioned will be prepared by Commissioning Provider during construction and will generally include a rigorous verification of instrument calibration, equipment performance, packaged equipment control system operations, automatic control sequence of operations, fire and life safety sequences, and operator interface functions. Commissioning Provider will supervise and document functional testing. Contractor shall provide qualified technicians to assist Commissioning Provider during on-site testing and perform the following functions.
  - 1. Provide 16 hours of onsite assistance to CxP by qualified building automation control technician.
  - 2. Operate equipment and systems as necessary to conduct testing.
  - 3. Manipulate control parameters to simulate test conditions as detailed in Functional Test Plans.
  - 4. Access control programming and database as required to verify control configuration or to correct observed deficiencies.
  - 5. Create graphic displays and/or trend report as required to document test results.
  - 6. Provide proprietary hardware and software as needed to interface with manufacturer's packaged control systems.
- B. Labor required for retesting due to failure of equipment, or systems not performing in accordance with Contract Documents shall be provided at no additional cost to Owner.

### **3.05 OPERATIONS AND MAINTENANCE TRAINING**

- A. The Contractor shall provide operation and maintenance instruction to Owner's personnel as required by Division 01 and 23.

### **3.06 SCHEDULE OF SYSTEMS BEING COMMISSIONED**

- A. Commission systems and equipment listed below, including associated equipment, piping, ductwork, and control systems.
- B. HVAC Systems: Air handling units, terminal devices, exhaust fans, building automation system.

**END OF SECTION**

**SECTION 230900**  
**INSTRUMENTATION AND CONTROL PERFORMANCE SPECIFICATIONS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Communications
  - 2. Operator Interface
  - 3. Controller Software
  - 4. Web Based Access
  - 5. BAS Graphics
  - 6. Building Controllers
  - 7. Application Specific Controllers
  - 8. Input/Output Interface
  - 9. Power Supplies and Line Filtering
  - 10. Control Panels
  - 11. Auxiliary Control Devices
  - 12. Wiring and Raceways
  - 13. Smoke Detection for Projects with a Building Fire Alarm System
- B. This is a performance specification and Contractor is responsible for design tasks and engineering.

**1.02 RELATED SECTIONS**

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Current edition of ANSI/ASHRAE Standard 135 and addendum, BACnet.
  - 2. Current edition of UL 916 Underwriters Laboratories Standard for Energy Management Equipment, Canada and the US.
  - 3. Current edition of FCC Part 15, Subpart J, Class A.
  - 4. Current edition of BACnet Testing Laboratories (BTL).

**1.04 SUBMITTALS**

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Prepare and submit a detailed schedule of work. Schedule to identify milestones such as equipment submittals, control panel diagrams, color graphic panel displays, Interlock.
  - 2. Wiring diagrams, control program sequence software flow chart diagrams, conduit layout diagrams, device location diagrams, equipment and component deliveries, installation sequencing, controller startup, point to point startup, control programming, sequence testing, commissioning/acceptance testing and training.
  - 3. Submit design drawings, sequences of operation, program listings, software flow charts and details for each typical piece of equipment and system being controlled. No work to be initiated or fabrication of any equipment started prior to the Owner's Authorized Representatives return of REVIEWED submittals.
    - a. Sequence of Operation: The sequence of operation included in the design documents is intended only to communicate the Engineers' general control intent and is not to be used as a direct reference for programming of the EMS system. Verbatim duplication of the Engineer's Sequence of Operation on the submittals is discouraged and may



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- result in non-approval of the submittal. Sequence of operation on submittals to accurately detail the system's intended programming, and include details of enhancements, adjustments, or deviations from the Engineer's sequence of operation. Submitted sequence of operation to be written with a logical and organized format and flow. Provide detailed, clear and unambiguous sequence of operation language. Point descriptors and point nomenclature referenced in the submitted sequence of operation to match those (to be) actually programmed. As-built submittal Sequence of Operation to include modifications to the programming made as a result of any addendum, bulletins, RFI's, change orders, and commissioning.
4. Format: Make each submittal in one complete and contiguous package. Partial or unmarked submittals will be rejected without review.
  5. Submit Manufacturers Data as Follows:
    - a. Complete materials list of items proposed to be furnished and installed. A complete Bill of Materials, listing materials, components, devices, wire and equipment are required for this work. The Bill of Materials to be separate for each controller on its own page(s) and to contain the following information for each item listed:
      - 1) Manufacturer's Name and Model number with furnished options highlighted.
      - 2) Quantity of each by controller location.
      - 3) Description of product (generic).
      - 4) Specified item.
      - 5) Operating range or span.
      - 6) Operating point or setpoint.
    - b. Manufacturer's specifications and other data required demonstrating compliance with the specified requirements, including but not limited to: Catalog cuts, technical data and descriptive literature on hardware, software, and system components to be furnished.
    - c. The data to be clearly marked and noted to identify specific ranges, model numbers, sizes, and other pertinent data. Submit printed manufacturer's technical product data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials and including printed installation instructions and start-up instructions.
    - d. Unless specifically called for otherwise, provide bound copies of catalog cuts for standard products, not requiring specifically prepared Shop Drawings, for the following:
      - 1) Wire and Cable, Class II
      - 2) Face Plates for Devices
      - 3) Disconnect Switches for Power Control
    - e. Where more than one item, size, rating or other variations appear on a catalog cut sheet, clearly identify items to be provided. These items to be properly indexed and referenced to identification numbers, designations and/or details on the Drawings.
  6. Shop Drawings: Submit shop drawings for each controlled system, depicting the following information:
    - a. Schematic flow diagram of system showing fans, pumps, coils, dampers, valves and other control/monitoring devices.
    - b. Label each control device with initial setting or adjustable range of control. Label points in schematic diagrams with termination at corresponding controller.
    - c. Electrical Wiring: Clearly differentiate between portions of wiring that are factory installed and portions of be field-installed.
    - d. Details of control panel faces, including controls, instruments, and labeling.
    - e. Interfaces to equipment furnished under other Specification Sections identifying numbers of wires, termination location, voltages and pertinent details. Responsibility for each end of the interfaces to be noted on these drawings whether or not they are a part of this Section.

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- f. System architecture diagram showing the global connectivity of new controllers and any existing systems that will be connected to.
7. Equipment locations, wiring and piping schematics, details, panel configurations, sizes, damper motor mounting details, valve schedules, and a points list keyed to specific hardware submittals. Control wiring depicted as fully annotated ladder diagrams with terminations identified, completely configured as to the exact panel, wiring, relay, switch, and component configuration.
8. Tag Number Lists: Develop instruments tag number system and submit list for approval. Coordinate methods and number block with the Owner's Authorized Representative.
9. Format the Shop and Field Drawings to Include:
  - a. A Title Sheet containing a drawing list, abbreviations list, symbols list, site and vicinity maps for project location and schedules.
  - b. Floor Plans showing proposed device locations and device nomenclatures.
  - c. A Riser Diagram illustrating conduit relationships between devices shown on the Floor Plans. Show device nomenclatures.
  - d. A Single-Line Diagram for each system showing signal relationships of devices within the system. Show device nomenclatures.
  - e. A Wiring Diagram for each assembly, enclosure or free standing device, showing:
    - 1) The Devices Within
    - 2) Wiring Connections
    - 3) Wire Identification
    - 4) Voltage Levels
    - 5) Fuse Ratings
  - f. Operations and Maintenance Manuals:
    - 1) Following approval of Shop Drawings of control equipment and prior to acceptance of control work, prepare Operating and Maintenance manuals describing operating, servicing, and maintenance requirements of control systems and equipment installed under this Section, in accordance the General and Special Conditions of these Specifications.
    - 2) Information contained in the manual for the above equipment to include the following:
      - (a) Manufacturer's catalog cuts and printed descriptive bulletins.
      - (b) Manufacturer's installation, operating, and maintenance instruction booklets. Complete instructions regarding the operation and maintenance of equipment involved.
      - (c) Instrument calibration certificates.
      - (d) Parts list and costs.
      - (e) Complete nomenclature of replaceable parts, list of recommended spare parts for 12 months operation, their part numbers, current cost and name and address of the nearest vendor of replacement parts.
      - (f) Name, address and telephone number for closest source of spare parts.
      - (g) Wiring and schematic diagrams.
      - (h) Include final record copies of shop drawings.
      - (i) Copy of guarantees and warranties issued for the various items of equipment, showing dates of expiration.
      - (j) Reduced plans, diagrams, and control schematics.
      - (k) Copies of test results.
      - (l) Control System Operating Manual including: point of summary and point data base; complete printout of program listings; magnetic tape CD or DVD backup of Field Control Cabinet programs; cabinet layout; hard copy of graphic screens; hard copy of specified reports.
  - g. A final Bill of Quantities including a separate schedule for portable equipment, if delivered as part of this work.

- h. Performance, Test and Adjustment Data: Comprehensive documentation of performance verification according to parameters specified in these specifications.
- i. Record Drawings: Comply with Division 01, General Requirements and Section 23 00 00, HVAC Basic Requirements. Provide complete as-built submittals including "as-programmed" sequence of operation as well as final occupancy schedules.

#### **1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Installer Qualifications: Company specializing in performing work of the type specified in this Section with minimum five years' experience in the local area. Installers required to have successfully completed manufacturer's control system factory training.

#### **1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

#### **1.07 SYSTEM DESCRIPTION**

- A. Control system referenced throughout specifications and drawings as Building Automation System (BAS), Building Management System (BMS), or Energy Management System (EMS) interchangeably consists of high-speed, peer-to-peer network of DDC controllers, control system server, and operator workstation.
- B. System software based on server/thin-client architecture, designed around open standards of web technology. Control system server accessed using a web browser over control system network, Owner's local area network, and remotely over Internet (through Owner's LAN). Intent of thin-client architecture is to provide operators complete access to control system via web browser. No special software other than web browser required to access graphics, point displays, and trends.
- C. Local Area Network (LAN) either 10 or 100 Mbps Ethernet network.
- D. System will consist of open architecture that is capable of:
  - 1. High speed Ethernet communication using TCP/IP protocol.
  - 2. Native BACnet communications according to ANSI / ASHRAE Standard 135, latest edition. Provide necessary BACnet-compliant hardware and software to meet the system's functional specifications. Controller devices must be BTL tested and listed by an official BACnet Testing Laboratory and have the BTL mark issued.
- E. Complete temperature control system to be DDC with electronic sensors and electronic/electric actuation valves and dampers.
- F. Prepare individual hardware layouts, interconnection drawings, building riser/architecture diagram and sequence of control from the project design data. Any architecture diagrams on design drawings have been included as schematics only and are not meant to portray quantity of devices or power/data requirements.
- G. Design, furnish, and install equipment cabinets, panels, data communication network infrastructure (including cables, conduits, outlets, connections, etc.) needed, and associated hardware.
- H. Provide complete manufacturer's specifications for items that are supplied. Include vendor name and model number of every item supplied.
- I. Provide a comprehensive operator and technician training program as described in these Specifications.
- J. Provide as-built documentation, operator's terminal software, diagrams, and other associated project operational documentation (such as technical manuals) on approved media, the sum

total of which accurately represents the final system.

- K. Provide 120V power, low voltage power, transformers, etc. for control panels, transformer panels, and BAS devices. Install per Division 26, Electrical Specifications. Power for devices within this Specification Section is solely the responsibility of the BAS Contractor.
- L. Conduit and raceway systems. Provide per Division 26, Electrical Specifications.
- M. Devices, components, controllers, and software to be manufacturer's most current version at the time of installation.

**1.08 SYSTEM PERFORMANCE**

- A. Performance Standards - System conforms to following minimum standards over network connections:
  - 1. Graphic Display: Graphic with 20 dynamic points display with current data within 10 seconds.
  - 2. Graphic Refresh: Graphic with 20 dynamic points update with current data within 8 seconds.
  - 3. Object Command: Devices react to command of binary object within 2 seconds. Devices begin reacting to command of analog object within 2 seconds.
  - 4. Object Scan: Data used or displayed at controller or workstation have been current within previous 6 seconds.
  - 5. Alarm Response Time: Object that goes into alarm is annunciated at workstation within 45 seconds.
  - 6. Program Execution Frequency: Custom and standard applications are capable of running as often as once every 5 seconds. Select execution times consistent with mechanical process under control.
  - 7. Performance: Programmable controllers are able to completely execute DDC PID control loops at frequency adjustable down to once per second. Select execution times consistent with mechanical process under control.
  - 8. Multiple Alarm Annunciation: Each workstation on network receive alarms within 5 seconds of other workstations.
  - 9. 10 percent additional spare capacity for each controller provided, for both digital and analog points.
  - 10. Graphics display software to include building floor plan and map of zones served.
- B. Reporting Accuracy: System reports values with minimum end-to-end accuracy listed in Reporting Accuracy Table below.

- 1. Reporting Accuracy Table:

Measure Variable	Reported Accuracy
Space Temperature	Plus or Minus 1 degree F
Ducted Air	Plus or Minus 1 degrees F
Outside Air	Plus or Minus 2 degrees F
Dew Point	Plus or Minus 3 degrees F
Delta-T	Plus or Minus 0.25 degree F
Relative Humidity	Plus or Minus 5 percent RH

- 2. Note 1: Accuracy applies to 10 percent-100 percent of scale
- 3. Note 2: For both absolute and differential pressure
- 4. Note 3: Not including utility-supplied meters

- C. Control Stability and Accuracy. Control loops maintain measured variable at setpoint within tolerances listed in Control Stability and Accuracy Table below.

- 1. Control Stability and Accuracy Table:

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	Plus or minus 0.2 inch	0-6 inch wg

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	wg	
	Plus or minus 0.01 inch wg	-0.1 to 0.1 inch wg
Airflow	Plus or minus 10 percent of full scale	
Space Temperature	Plus or minus 2.00 degrees F	
Duct Temperature	Plus or minus 3.0 degrees F	
Humidity	Plus or minus 5 percent RH	

**PART 2 - PRODUCTS**

**2.01 OREGON/WASHINGTON MANUFACTURERS**

- A. Siemens
- B. Honeywell
- C. Alerton
- D. Automated Logic (ALC)
- E. Delta Controls
- F. Trane
- G. JCI
- H. Duct/Spot-Type Smoke Detectors (Project with Fire Alarm System):
  - 1. See Division 28 for Products.

**2.02 COMMUNICATIONS**

- A. Each controller to have communication port for connection to operator interface.
  - 1. Internetwork operator interface and value passing to be transparent to internetwork architecture.
  - 2. Operator interface connected to controller to allow operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, reports, system software, and custom programs to be viewable and editable from each internetwork controller.
- B. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers to be readable by each controller on internetwork.
- C. Operator Workstation to be capable of simultaneous direct connection and communication with BACnet/IP, OPC and TCP/IP networks without use of interposing devices such as PC or gateway with hard drive.
- D. Workstations, Building Control Panels and Controllers with real-time clocks use time synchronization service. System automatically synchronizes system clocks daily from operator-designated device via internetwork. System automatically adjusts for daylight savings and standard time as applicable.
- E. Wireless Network Communications:
  - 1. Wireless communications take place using modular wireless transceivers at each device, which eliminates need for communication cabling.
  - 2. Wireless transceiver utilizes 2.4 GHz in license free global Industrial Scientific and Medical (ISM) band.
  - 3. Wireless transceiver is encased in plenum-rated enclosure. If application dictates, wireless transceiver is able to be installed in metal enclosure utilizing remote mounted antenna.

4. Wireless transceiver channel is factory set and capable of being field set to different channel if interference with IEEE 802.11 devices or other 2.4 GHz products is encountered.
5. Wireless transceiver is 24 VAC powered.
6. Wireless transceiver gives a visual indication that it is powered and communicating.
7. Wireless transceiver has a field-settable network identifier that allows multiple networks to occupy same channel for maximum scalability.

### 2.03 OPERATOR INTERFACE

- A. Operator Interface: PC-based workstations reside on high-speed network with building controllers. Each workstation or each standard browser connected to server is able to access system information.
- B. Hardware: Each operator workstation or web server consists of the following:
  1. Computer: Hardware meets or exceeds DDC system manufacturer's recommended specifications and meet response times specified elsewhere in this document. Following hardware requirements also apply:
    - a. Hard disk have sufficient memory to store:
      - 1) Required operator workstation software.
      - 2) 24 months of trend data based on points specified to be trended at specified trend intervals.
    - b. Minimum hardware configuration includes:
      - 1) Intel i7 Processor
      - 2) 22-in LCD Monitor with at least 1024 x 768 Resolution
      - 3) 8 GB of RAM
      - 4) 48x CD-RW/DVD Optical Drive
      - 5) 1 TB Hard Disk Drive Providing Data at 3 GB/sec
      - 6) Ethernet 10/100 Network Interface Card
      - 7) High Performance Graphics Card
      - 8) Keyboard and Mouse
      - 9) Color Inkjet Printer
      - 10) UPS (uninterruptible power supply) installed at server, sized with sufficient capacity to allow full operation for 10 minutes or more.
  2. Portable Operator's Terminal: Portable Operator's Terminal capable of accessing system data. This device may be connected to any point on system network or to any controller for programming, setup, and troubleshooting. Portable Operator's Terminal is IBM-compatible notebook-style PC including software and hardware required. PC contains at minimum:
    - a. Intel i5 Processor
    - b. 15-in LCD Monitor with at least 1024 x 768 Resolution
    - c. 8 GB of RAM
    - d. 1 TB Hard Drive
    - e. Touch-Pad or Other Internal Pointing Device
    - f. High-Performance Graphics Adapter
    - g. Ethernet 10/100 Network Interface Card
    - h. Integrated Wireless 802.11 b/g/n
    - i. Serial Port and CD/RW-ROM
- C. System Software:
  1. Operating System: Furnish concurrent multi-tasking operating system. Operating system also supports use of and includes other common software applications such as Microsoft Excel, Word, Microsoft Access and Adobe Acrobat. Acceptable operating systems are Windows 7 and Windows 10.
  2. Dynamic Color Graphics:

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- a. Real-time color graphic displays dynamic and able to update displays.
  - b. Provide operator ability to change values (setpoints) and states in system controlled equipment directly from graphic display.
  - c. Custom Graphics. Provide custom graphics generation package.
  - d. Graphics Library. Furnish library of standard HVAC equipment graphics and include standard symbols for fans, pumps, coils, valves, piping, dampers, and ductwork.
3. Software to be manufacturer's most current version at the time of installation.
- D. System Applications: Each workstation provides operator interface and off-line storage of system information. Provide following applications at each workstation:
1. Automatic System Database Save and Restore: Each workstation stores on hard disk copy of current database of each Building Controller. This database automatically updated whenever change is made in any system panel.
  2. Manual Database Save and Restore: System operator able to manually save or clear database and initiate download of specified database from/to any panel.
  3. System Configuration: Workstation software provides method of configuring system to allow for changes or additions by users and performs following tasks:
    - a. Create, delete or modify control strategies.
    - b. Add/delete objects to system.
    - c. Tune control loops through adjustment of control loop parameters.
    - d. Enable or disable control strategies.
    - e. Generate hard copy records of control strategies on printer.
    - f. Select points to be alarmed and define alarm state.
    - g. Select points to be trended and initiate automatic recording of values.
    - h. Start/Stop binary objects and adjust analog objects.
  4. Security: Operator required to log on to system with user name and password in order to view, edit, add, or delete data. System security selectable for each operator.
  5. System Diagnostics: System automatically monitor operation of workstations, printers, modems, network connections, building management panels, and controllers. Failure of any device to be annunciated.
  6. Alarm Indication and Handling:
    - a. Workstation provides visual means of alarm indication. Alarm indication becomes highest priority regardless of application(s) running.
    - b. System provides and archive log of alarm messages to hard drive. Alarm messages to include description of event-initiating object, source, location and time/date of alarm.
  7. Trend Logs: Operator able to define custom trend log for any data object and include interval, start time, and stop time. Trend data sampled and stored on building controller panel, is archived on hard disk, and is retrievable for use in spreadsheets and standard database programs.
    - a. System server to periodically gather historically recorded data stored in the building controllers and archive the information. Archived files to be appended with new sample data, allowing samples to be accumulated.
    - b. Software to be included that is capable of graphing the trend logged object data. Software capable of creating two-axis (x,y) graphs that display object values relative to time.
    - c. Operator able to change trend log setup information. This includes the information to be logged as well as the interval at which it is to be logged. Input, output, and value object types in the system may be logged. Provide operations password protected. Setup and viewing may be accessed directly from any graphics on which object is displayed.
    - d. BAS Contractor to enable trending for any system points (physical or virtual) as directed by the Engineer, Owner or Commissioning Authority (Commissioning Authority). There will be no limit on the number of trended points the BAS Contractor

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- is to set up. BAS Contractor will modify trend setup parameters as directed by the Commissioning Authority during testing. BAS Contractor to be proactive and enable trending for major system points during system startup/programming. BAS Contractor is not to wait for direction to begin trending points. Trend data for each point to be archived on the main server for a minimum of one year. Trend data archiving to be enabled immediately upon trend setup, or as soon as communication between the field panel and sever is established. Trend data uploads from field panel to server set up to be automatically performed with sufficient frequency to ensure no data gaps or loss of trend data. At a minimum, provide the following to the Commissioning Agent:
- 1) 24 hour trend logs for all scheduled mechanical equipment controlled through the DDC control system.
  - 2) BAS screen shots.
- e. Trend points as identified in the points list. Provide system specific trend data in two-axis (x,y) graphs that display object values relative to time to Engineer, Owner, or Commissioning Authority.
8. Standard Reports: Standard system reports provided for this project. Provide ability for Owner to readily customize these reports for this project:
- a. Objects: System (or subsystem) objects and their current values.
  - b. Logs:
    - 1) Alarm History
    - 2) System Messages
    - 3) System Events
    - 4) Trends
9. Electrical, Gas, and Weather Report:
- a. System server capable of periodically gathering energy log data stored in the field equipment and archive the information. Archive files appended with new data, allowing data to be accumulated.
  - b. Operator able to change the energy log setup information as well. This includes the meters to be logged, meter pulse value, and the type of energy units to be logged. Meters monitored by the system may be logged.
  - c. System to display archived data in tabular format form for both consumption and peak values. Data shown in hourly, daily, weekly, monthly and yearly formats. In each format the user able to select a specific period of data to view.
  - d. Electrical Meter Report: Provide monthly report showing daily electrical consumption and peak electrical demand with time and date stamp for each building meter and for each electrical sub-meter on individual building panels, circuits, equipment (such as chillers), and variable frequency drives. Provide an annual (12-month) report showing monthly electrical consumption and peak electrical demand with time and date stamp for each individual meter.
  - e. Gas Meter Report: Provide monthly report showing daily natural gas consumption for each meter and sub-meter. Provide annual (12-month) report that shows monthly consumption for each meter.
  - f. Weather Data Report: Provide monthly report showing daily minimum, maximum, and average outdoor air temperature (dry bulb, wet bulb) and humidity. Provide annual (12-month) report showing minimum, maximum, and average outdoor air temperature for month.
- E. Interfaces to Third Party Systems: BAS connects to third party systems (VFDs, chillers, emergency generators, rooftop AC units, etc.). Communication protocol specified for third party system, and BAS provides compatible protocol to assure proper two way communication. Points, alarms, and commands displayed on BAS as indicated.
- F. Workstation Applications Editors: Each PC workstation supports editing of system applications, which downloaded and executed at one or more controller panels.



## 2.04 CONTROLLER SOFTWARE

- A. Furnish following applications software for building and energy management. Software applications reside and operate in system controllers. Software to be manufacturer's most current version at the time of installation. Software and associated functions (scheduling, optimum start/stop, etc.) noted in this specification are to be configured and enabled for this project. Incorporate into sequence of operation submittals for review prior to installation.
- B. System Security:
  - 1. User access secured using individual security passwords and user names. Security to have a minimum of three levels of operator privilege restricted to specific operators.
  - 2. Restrict user passwords to objects, applications, and system functions as assigned by system manager. Provide monitoring only access to Engineer of Record and Commissioning Authority for period of one year for trouble shooting purposes.
  - 3. Record user Log On/Log Off attempts.
  - 4. Provide passwords, user names, and access assignments adjustable at the operator's terminal. Each user to have a set security level, which defines access to displays and individual objects the user may control. System to include 10 separate and distinct security levels for assignment to users.
  - 5. System to include an Auto Logout Feature that will automatically logout user when there has been no keyboard or mouse activity for a set period of time. Time period to be adjustable by system administrator. Auto Logout may be enabled and disabled by system administrator. Operator terminal to display message on screen that user is logged out after Auto Logout occurs.
- C. Scheduling: Provide capability to schedule each object or group of objects in system. Coordinate schedule with Owner and program accordingly. Each schedule consists of:
  - 1. Operator's workstation to show information in easy-to-read daily format. Priority for scheduling: Events, holidays and daily with events being the highest.
  - 2. Holiday and special event schedules to display data in calendar format. Operator able to schedule holidays and special events directly from these calendars.
  - 3. Operator able to change information for a given weekly or exception schedule if logged on with the appropriate security access.
- D. Optimum Start/Stop: Provide software and program system to start equipment on sliding schedule based upon indoor and outdoor conditions. Determine minimum time of HVAC system operation needed to satisfy space environmental requirements and also determine earliest possible time to stop mechanical systems (i.e. shut down cooling/heating and only provide ventilation one hour prior to scheduled unoccupied period.). Optimum start/stop program operates in conjunction with scheduled start/stop and night setback programs.
- E. Alarms:
  - 1. Operator's workstation to provide visual means of alarm indication. The alarm dialog box to always become the top dialog box regardless of the application(s), currently running.
  - 2. System to provide log of alarm messages. Alarm log to be archived to the hard disk of the system operator's terminal. Each entry to include a description of the event-initiating object generating the alarm. Entry to include time and date of alarm occurrence.
  - 3. Alarm messages in user-definable text and entered either at the operator's terminal or via remote communication.
  - 4. Each binary object set to alarm based on operator-specified state.
  - 5. Each analog object have both high and low alarm limits.
  - 6. Alarms must be able to be automatically and manually disabled.
  - 7. Alarms are routed to appropriate workstations based on time and other conditions. An alarm is able to start programs, print, be logged in event log, generate custom messages, and display graphics.
  - 8. System have ability to dial out in event of alarm.
  - 9. Alarm Levels:

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- a. Provide 5 levels of alarm as follows, and program alarm levels for every required and specified alarm:
    - 1) Level 1: Critical/life safety.
    - 2) Level 2: Significant equipment failure.
    - 3) Level 3: Non-critical equipment failure/operation.
    - 4) Level 4: Energy conservation monitor.
    - 5) Level 5: Maintenance indication, notification.
  - b. Prior to training of Owner's Authorized Representative, submit the complete Points List and suggested Alarm Levels to the Owner.
  - c. During training of Owner's Authorized Representative(s):
    - 1) Discuss Alarm Levels and the alarms currently included in the BAS.
    - 2) Provide additional alarms without addition of new hardware points, as required by Owner's Authorized Representative.
    - 3) Agree with the Owner's Authorized Representative on action(s) to be taken for each alarm level and implement same for each alarm. Said action to include visual and/or audible alarm(s) at the Operator workstation including whether Operator acknowledgement is required or not, email messages, and text messages.
- F. Demand Limiting:
1. System to include demand limiting program that includes two types of load shedding. One type of load shedding to shed/restore equipment in binary fashion based on energy usage when compared to shed and restore settings. The other type of shedding to adjust operator selected control setpoints in an analog fashion based on energy usage when compared to shed and restore settings. Shedding may be implemented independently on each and every zone or piece of equipment connected to system.
  2. Status of each and every load shed program capable of being displayed on every operator terminal connected to system. Status of each load assigned to an individual shed program displayed along with the description of each load.
  3. Demand-limiting program monitor building power consumption from signals generated by pulse generator (provided by BAS contractor) mounted at building power meter or from watt transducer or current transformer attached to building feeder lines.
  4. Demand-limiting program predicts probable power demand so that when demand exceeds demand limit, action will be taken to reduce loads in predetermined manner. When demand limit will not be exceeded, action will be taken to restore loads in predetermined manner.
- G. Maintenance Management: System monitors equipment status and generate maintenance messages based upon user-designated run-time, starts, and/or calendar date limits. Coordinate settings with Owner.
- H. Sequencing: Provide application software based upon sequences of operation specified to properly sequence designated systems. Provide points to achieve specified sequences.
- I. Staggered Start: This application prevents controlled equipment from simultaneously restarting after a power outage. Order in which equipment (or groups of equipment) is started, along with time delay between starts to be user-selectable.
- J. Energy Calculations: Provide software to allow instantaneous power (e.g. kW) or flow rates (e.g. L/s (gpm)) to be accumulated and converted to energy usage data.
- K. Anti-Short Cycling: Binary output objects protected from short cycling by allowing minimum on-time and off-time to be selected.
- L. On/Off Control with Differential: Provide algorithm that allows binary output to be cycled based on controlled variable and setpoint. Algorithm direct-acting or reverse-acting and incorporate adjustable differential.
- M. Run-Time Totalization: Provide software to totalize run-times for binary input objects.

## **2.05 WEB BASED ACCESS**

- A. General Description: BAS supplier to provide web-based access to the system as part of standard installation. Provide access to user of displays of real-time data that are part of the BAS via a standard Web browser. Web browser to tie into the network via Ethernet network connection. Provide web-page host that resides on the BAS network. Web-page software not to require a per user licensing fee or annual fees. The web-page host must be able to support at least 50 simultaneous users with the ability to expand the system to accommodate an unlimited number of users. Software to be manufacturer's most current version at time of installation.
- B. Browser Technology: Browser to be standard version of Microsoft Internet Explorer (latest edition). No special vendor-supplied software needed on computers running browser. Displays viewable and the Web-page host to directly access real-time data from the BAS network. Data displayed in real time and update automatically without user interaction. User able to change data on displays if logged in with the appropriate user name and password.
- C. Display of Data: Web page graphics shown on browser to be replicas of the BAS displays. User to need no additional training to understand information presented on Web pages when compared to what is shown on BAS displays. Web page displays to include animation just as BAS displays. Fans to turn, pilot lights to blink, and coils to change colors, and so on. Real-time data shown on browser Web pages. This data must be directly gathered via the BACnet network and automatically updated on browser Web page displays without any user action. Data on the browser to automatically refresh as changes are detected without re-drawing the complete display. User to be able to change data from browser Web page to if the user is logged on with the appropriate password. Clicking on a button or typing in a new value to change digital data. Using pull-down menus or typing in a new value to change analog data. Data displays navigated using pushbuttons on the displays that are simply clicked on with the mouse to select a new display. Alternatively, the standard back and forward buttons of the browser can be used for display navigation.
- D. Web Page Generation: Web pages generated automatically from the BAS displays that reside on the BAS server. User to access Web-page host via the network and initiate a web page generation utility that automatically takes the BAS displays and turns them into Web pages. The Web pages generated are automatically installed on the Web page host for access via any computer's standard browser. Any system that requires use of an HTML editor for generation of Web pages will not be considered.
- E. Password Security and Activity Log: Access via Web browser to utilize the same hierarchical security scheme as BAS system. User asked to log in once the browser makes connection to Web-page host. Once the user logs in, any changes that are made to be tracked by the BAS system. User able to change only those items that the user has authority to change. A user activity report to show any activity of the users that have logged in to the system regardless of whether those changes were made using a browser or via the BAS workstation.
- F. Communication: Web-page host to communicate using the specified protocol standard to devices on the BAS network.

## **2.06 BAS GRAPHICS**

- A. Develop customized graphics showing the project building(s) and their floor plans, mechanical, and electrical equipment, flow and control diagrams, and other relevant features on Workstation graphic screens. Associated input, output, and virtual objects (e.g., temperature and pressure setpoints) listed in the Sequence of Operation, and shown on the Input/Output Objects List included in the graphic screens and bound to the database. Real-time value of objects updated on the display of each graphic automatically. For projects where existing campus and/or building controls systems exist, replicate graphics used in the existing BAS graphics screens.
- B. Graphics to have links to the Print function and to display a Standard Legend in the corner of the graphic. Graphics, except pop-ups, to have the date and time displayed in the upper corner of the graphic. Each graphic titled.

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- C. Weather: Graphics, except pop-ups, to have the outdoor temperature and humidity in the upper corner of the graphic.
- D. Alarms: System and component summary alarms located near the top of each relevant graphic screen. Provide links to the associated system/component as part of these tags to assist trouble shooting. Other alarms placed near the associated system/device as depicted in the graphic. Provide text and color of information tags that describe each object and alarm value consistent with a graphics color legend.
- E. The Following Graphics Provided as a Minimum:
  - 1. A building graphic, typically a photograph of the building, with links to each floor plan and other links as defined below.
  - 2. A central plant graphic with equipment (chillers, boilers, pumps, heat exchangers, storage tanks, etc.), temperature sensors, pressure sensors, flow sensors and refrigeration leak detectors. The central plant graphic to have links to each building on the campus.
  - 3. Central equipment such as air handler, package rooftop equipment, supply fans, exhaust fans, and smoke control systems.
  - 4. Floor plans of each floor, with temperature sensors, pressure sensors, temperature control zones, heating/cooling zones, ventilation zones, and supply air zones identified. Rooms grouped on a graphic only to the extent that detailed and complete sensing information can be comfortably viewed by an operator and the bound points updated in less than 10 seconds. Each zone to have a temperature symbol that changes color over the range from low (blue) through normal (green) to high (red) and indicate an alarm (flashing red). The zone temperature and or pressure symbol(s) to be a link to a zone control pop-up graphic. Individual floor plan graphics to provide links to related mechanical systems. The mechanical room plan graphics to show the relative location of, and provide links to, either the equipment pop-up or flow and control graphic for mechanical equipment monitored or controlled by the BAS.
  - 5. Pop-up graphics provided for each zone control system showing a flow diagram and related monitoring and control points and system parameters. Pop-up graphics provided for each piece of equipment that is not shown on a flow and control graphic.
  - 6. Control diagrams for each system including but not limited to fan coils and combination fire and smoke damper status. The control graphics to have parameters grouped in the lower portion of the graphics. Standard equipment graphics used. Pumps, fans, dampers and other elements to dynamically indicate their state (i.e. pumps and fans to rotate when on and damper positions to dynamically adjust and be shown in their current position, etc.). System flow and control graphics displayed in a general left to right flow or loop arrangement. Return and exhaust air flow shown on top and return water shown on the bottom of the graphic.
  - 7. Individual equipment/component screens showing sensing and control information available for each device provided.
- F. Penetration: The graphic interface to consistently apply a convention whereby a left-click to always penetrate to more detailed information. The text windows to represent the deepest level of penetration. A right-click to always produce a menu of options that are specific to the item selected.
- G. Navigation: Graphics organized to provide a "branching structure" that allows an operator to move from a "macro view" to a "micro view" and return. These links to other associated graphics, or allow a return to a previous macro view, provided and arranged horizontally along the bottom of each graphic screen. From left to right, the graphic links as follows: site/building map, building/trailer floor plans, and major mechanical systems at each building. Pop-up right click menus provided as needed on the lower button bar to allow for uncluttered navigation.
- H. Clutter Minimization: Each graphic to have separate check boxes in the lower right corner that show/hide setpoints, alarms/safeties, and devices/equipment.

- I. Templates: To the maximum extent possible, use standard graphics as templates to provide a consistent look throughout the interface.
- J. Color Scheme: The graphics to use dynamic color changes to communicate equipment type, or object status consistent with the graphics color legend.
- K. Symbols and Animations: Fans, pumps, dampers, coils, and generation equipment to be dynamic symbols indicating rotation, state, or position, movement, flow, etc.
- L. Macros: When macros are used to add functionality to the graphics, detailed documentation provided.
- M. Configure Mode: Access to "Configure Mode" for editing of the graphics password protected to prevent unauthorized changes to the graphics. This password supplied to the appropriate personnel.
- N. Graphics Version: Graphics provided in the most current format available at time of control system programming.
- O. Points and graphics checked for the proper binding and graphic programming, settings to ensure that the correct system, location, point values and dynamics are shown in the proper location and rotate in the proper directions.
- P. After graphics have been accepted, provide, on a CD ROM in an agreed upon file structure. If the graphics have active-x controls or other files that must be placed outside the graphics folder structure a set-up program provided on the disk to place the files in the correct locations.

## **2.07 BUILDING CONTROLLERS**

- A. General: Provide adequate number of building controllers to achieve performance specified. Panels to meet the following requirements.
  - 1. Building Automation System (BAS) to be composed of one or more independent, stand-alone, microprocessor-based building controllers to manage global strategies described in Controller Software article.
  - 2. Provide sufficient memory to support operating system, database, and programming requirements.
  - 3. Share data between networked building controllers.
  - 4. Distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
  - 5. Controllers that perform scheduling have real-time clock.
  - 6. Continually check status of its processor and memory circuits and if abnormal operation is detected, controller:
    - a. Assume predetermined failure mode.
    - b. Generate alarm notification.
  - 7. Building Controller communicates with other devices on internetwork including BACnet communications according to specified protocol.
- B. Communication:
  - 1. Each building controller resides on network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and performs routing to network of custom application and application specific controllers.
  - 2. Controller provides a service communication port for connection to a portable operator's terminal.
- C. Environment:
  - 1. Controllers used outdoors and/or in wet ambient conditions mounted within NEMA waterproof enclosures and rated for operation at 0 degrees F to 150 degrees F.
  - 2. Controllers used in conditioned space are mounted in NEMA dust-proof enclosures and rated for operation at 32 degrees F to 120 degrees F.

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- D. Keypad: Local keypad and display to be provided for each controller. Security password to be available to prevent unauthorized use of keypad and display.
- E. Serviceability: Provide diagnostic LEDs for power, communication, and processor. Wiring connections are made to modular terminal strips or to termination card connected by ribbon cable.
- F. Memory: Building controller maintains BIOS and programming information in event of power loss for at least 72 hours.
- G. Immunity to power and noise. Controller able to operate at 90 percent to 110 percent of nominal voltage rating and performs an orderly shutdown below 80 percent nominal voltage. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3-feet.
- H. Controller to have a battery to provide power for orderly shutdown of controller and storage of data in nonvolatile flash memory. Battery backup to maintain real-time clock functions for a minimum of 10 days.

## 2.08 APPLICATION SPECIFIC CONTROLLERS

- A. Application specific controllers (ASCs) are microprocessor-based DDC controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. Controllers to be fully programmable using graphical programming blocks.
  - 1. ASC controllers communicate with other devices on internetwork.
  - 2. Each ASC capable of stand-alone operation without being connected to network.
  - 3. Each ASC will contain sufficient I/O capacity to control target system.
  - 4. Application controllers to include universal inputs with minimum 10-bit resolution that accept thermistors, 0-10VDC, 0-5 VDC, 4-20 mA and dry contact signals. Any input on a controller may be either analog or digital with at least 1 input that accepts pulses. Controller to also include support and modifiable programming for interface to intelligent room sensor with digital display. Controller to include binary and analog outputs on board. Provide analog outputs switch selectable as either 0-10VDC or 0-20mA. Software to include scaling features for analog outputs. Application controller to include 24VDC voltage supply for use as power supply to external sensors.
  - 5. Program sequences stored on board application controller in EEPROM. No batteries needed to retain logic program. Program sequences executed by controller 10 times per second and capable of multiple PI and PID loops for control of multiple devices. Calculations completed using floating-point math and system to support display of information in floating-point nomenclature at operator's terminal. Programming of application controller completely modifiable in the field over installed BAS LANs or remotely via modem interface. Operator to program logic sequences by graphically moving function blocks on screen and tying blocks together on screen.
  - 6. Application controller to include support for room sensor. Display on room sensor programmable at application controller and include an operating mode and a field service mode. Provide button functions and display data programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.
- B. Communication:
  - 1. Controller resides on network using MS/TP Data Link/Physical layer protocol.
  - 2. Each controller connected to building controller.
  - 3. Each controller capable of connection to laptop computer or portable operator's tool.
- C. Environment:
  - 1. Controllers used outdoors and/or in wet ambient conditions mounted within NEMA waterproof enclosures and rated for operation at 0 degrees F to 150 degrees F.
  - 2. Controllers used in conditioned space mounted in NEMA dust-proof enclosures and rated for operation at 32 degrees F to 120 degrees F.

- D. Serviceability: Provide diagnostic LEDs for power, communication, and processor.
- E. Memory: ASC use nonvolatile memory and maintains BIOS and programming information in event of power loss.

## **2.09 INPUT/OUTPUT INTERFACE**

- A. Input/output points protected such that shorting of point to itself, to another point, or to ground will cause no damage to controller. Input and output points protected from voltage up to 24 V.
- B. Binary inputs (BI or DI) allow monitoring of On/Off signals from remote devices. Binary inputs sense “dry contact” closure without external power (other than that provided by controller) being applied.
- C. Pulse accumulation input objects accept up to 10 pulses per second for pulse accumulation.
- D. Analog inputs (AI) allow monitoring of low-voltage (0 to 10 VDC), current (4 to 20 mA), or resistance signals (thermistor, RTD).
- E. Binary outputs (BO or DO) provide for On/Off operation or pulsed low-voltage signal for pulse width modulation control. Binary outputs on building and custom application controllers have three-position (On/Off/Auto) override switches and status lights. Outputs selectable for either normally open or normally closed operation.
- F. Analog outputs (AO) provide a modulating signal for control of end devices. Outputs provide either a 0 to 10 VDC or a 4 to 20 mA signal as required to provide proper control of the output device. Analog outputs on building controllers have status lights and two-position (AUTO/MANUAL) switch and adjustable potentiometer for manual override. Analog outputs not exhibit drift of greater than 0.4 percent of range per year.
- G. Tri-State Outputs. Provide tri-state outputs (two coordinated binary outputs) for control of three-point floating type electronic actuators without feedback. Use of three-point floating devices limited to zone control and terminal unit control applications (VAV terminal units, duct-mounted heating coils, zone dampers, radiation, etc.). Control algorithms run zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.

## **2.10 POWER SUPPLIES AND LINE FILTERING**

- A. Control transformers UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in both primary and secondary circuits. Limit connected loads to 80 percent of rated capacity.
- B. DC power supply output match output current and voltage requirements. Unit operates between 32 degrees F and 120 degrees F.
- C. Line voltage units UL listed and CSA approved.
- D. Power line filtering. Provide transient voltage and surge suppression for workstations and controllers.

## **2.11 CONTROL PANELS**

- A. Control Panels:
  - 1. Enclosures may be NEMA 1 when located in a clean, dry, indoor environment. Indoor enclosures to be NEMA 12 when installed in other than a clean environment. Outdoor enclosures must be NEMA 3R. Provide (hinged door) key-lock latch and removable subpanels. Single key common to field panels and subpanels. In existing campus or building settings, key lock to match existing keys.
  - 2. Interconnections between internal and face-mounted devices prewired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections UL listed for 600 volt service, individually identified per control/ interlock drawings, with adequate clearance for field wiring. Control terminations for field connection individually identified per control drawings.

3. Provide ON/OFF power switch with overcurrent protection for control power sources to each local panel.
4. Provide laminated plastic nameplates for enclosures in any mechanical room or electrical room labeled with TCP number. Laminated plastic to be 1/8-inch thick sized appropriately to make label easy to read.

## 2.12 AUXILIARY CONTROL DEVICES

### A. Temperature Instruments:

1. Low-voltage or Line-voltage Thermostats: Bimetal-actuated, snap acting SPDT contact, enclosed, UL listed for electrical rating, exposed setpoint adjustment on cover with heat anticipator. Thermostat operates within 55 degrees F to 85 degrees F setpoint range, with 2 degrees F maximum differential.
2. Room Temperature Sensors: Thermistor or platinum RTD type with accuracy of plus or minus 0.5 degrees F at 70 degrees F; operating range 30-120 degrees F; linear signal; single point sensing element in wall-mounted ventilated enclosure with insulating back plate if mounted on exterior wall; plug-in portable operators terminal port.
3. Room Temperature Sensor: Thermistor or platinum RTD type with accuracy of plus or minus 0.5 degrees F at 70 degrees F; operating range 30-120 degrees F; linear signal; single point sensing element in wall-mounted ventilated enclosure with insulating back plate if mounted on exterior wall; push button for occupancy override; digital setpoint adjustment plus or minus 2 degrees F in both directions; LCD temperature display indicating setpoint only. Setpoint adjustment to revert to building programmed standard temperature upon next building occupancy schedule change (user adjustable). Room temperature sensor may have integral space carbon dioxide sensor with minimum performance characteristics identified within this specification. Include integral occupancy sensor for public rooms but not in offices.
4. Averaging Duct Temperature Sensors: Thermistor or platinum RTD element with accuracy of plus or minus 0.5 degrees F at 32 degrees F, consisting of array of single point sensing elements, securely mounted in duct or plenum; operating range 20-120 degrees F; linear signal; 1-foot element per 2 SF of duct cross-sectional area. Use when duct is 9 SF or larger or where air is subject to temperature stratification.
5. Probe Duct Temperature Sensors: Thermistor or platinum RTD element with accuracy of plus or minus 0.5 degrees F at 32 degrees F, consisting of single point sensing elements, securely mounted in duct or plenum; operating range 20-120 degrees F; linear signal; 24-inch rigid probe. Use where duct is less than 9 SF cross-sectional area.
6. Outside Air Temperature Sensor: Thermistor or platinum RTD element with accuracy of plus or minus 0.5 degrees F at 32 degrees F; Range -58 to 120 degrees F, single element, linear, with weather and sun shield for exterior mounting.
7. Low Temperature Limit Thermostat: Minimum 20 foot capillary sensing element, triggering on low temperature as sensed by any 12-inch segment; snap acting, normally open contacts, manual reset, line voltage.

### B. Humidity Sensors:

1. Space Humidity Sensors: Operating range 10 to 95 percent relative humidity, accuracy plus or minus percent RH, surface mounted ventilated enclosure for wall mounting.
2. Duct Humidity Transmitter: Capacitive type sensor and transmitter, linear output signal; automatic temperature compensating; air filter; plus or minus 2 percent RH accuracy from 0 to 100 percent RH.
3. Humidity sensor's drift not exceed 1 percent of full scale per year.

### C. Dewpoint Transmitter:

1. Uninterrupted, accurate and stable dewpoint measurement in condensing environments. Provide with integral temperature sensor.
2. Calculate:
  - a. Relative Humidity



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- b. Absolute Humidity
  - c. Difference between ambient and dewpoint temperature.
  - d. Mixing Ratio of Air
  - e. Wet Bulb Temperature of Air
  3. Provide hand held field calibration.
  4. Provide with local display and connection to BAS (analog output signal from device to BAS 4-20 mA signal).
  5. Dust and Chemical Resistant
  6. NEMA 4 Housing
  7. NIST Traceable with Certificate
  8. Specifications:
    - a. Dewpoint Measurement Range:-40 degrees F to 212 degrees F
    - b. Response Time: 15 seconds
    - c. Temperature Measurement Range:40 degrees F to 356 degrees F
    - d. Accuracy: 0.18 degrees F
    - e. Typical Ranges:
      - 1) Relative Humidity: 0 to 100 percent
      - 2) Dewpoint Difference: 0 to 90 degrees F
      - 3) Mixing Ration: 0 to 3500 gr/lb
      - 4) Absolute Humidity: 0 to 262 gr/ft<sup>3</sup>
      - 5) Wet Bulb Temperature: 32 degrees F to 212 degrees F
  9. Manufacturers:
    - a. Vaisala HMP243 with HMK41 field calibrator.
    - b. Or approved equivalent.
- D. Pressure Transmitters and Transducers:
1. Transducer have linear output signal; field adjustable zero and span. Sensing elements withstand continuous operating conditions of positive or negative pressure 50 percent greater than calibrated span without damage.
  2. Differential Pressure Switch: Setpoint adjustable with operating range of 0.5 to 12-inch WG for fans, and 5 to 30-feet WC for pumps. Switches UL listed; SPDT snap-acting; pilot duty rated (125 VA minimum); NEMA 1 enclosure; scale range and differential suitable for intended application.
  3. Filter Differential Pressure Switch: Setpoint adjustable with operating range of 0.1 to 5-inch WG; auto reset. Contactor to close when pressure differential setting is met or exceeded. Provide mounting bracket, metallic tubing and appropriate fittings for connection to duct or air-handling unit.
  4. Duct Static Differential Pressure Transducer: Operating range 0 to 5-inch WC for duct mounted transmitter; ceramic capacitive sensing element with probe securely mounted in duct; digital input terminal and push button to zero output. Accuracy plus or minus 1 percent of full scale; maximum response time 2 seconds.
- E. Motorized Control Dampers:
1. Performance: Maximum leakage of 3 CFM/SF at 1-inch WG differential pressure, AMCA Class 1A, maximum pressure rating of 13-inch WG differential pressure, maximum velocity of 6,000 fpm, -72 degrees F to 275 degrees F temperature rating.
  2. Multi-blade type, except where either dimension is less than 10-inch single blade may be used. Maximum blade length to be 48-inch.
  3. Provide parallel blades for modulating mixing service and opposed blades for throttling service.
  4. Blades to be interlocking; minimum 16 gauge galvanized steel; compression type edge seals and side seating stops. In copper, aluminum and stainless steel duct work, damper material matches duct work material.

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5. Damper blades are reinforced, have continuous full length axle shafts, axle to axle linkage, and/or operating "jackshafts" as required to provide coordinated tracking of blades.
  6. Bearings: Self-lubricating stainless steel sleeve or Celcon bearing.
  7. Dampers over 25 SF in area to be in two or more sections, with interconnected blades.
  8. Provide remote damper blade position status with binary input.
  9. Tested in accordance with AMCA Standard No. 500.
- F. Electric Damper/Valve Actuators:
1. Provide mechanical or electronic stall protection for each actuator.
  2. Where indicated provide internal mechanical, spring-return mechanism or provide uninterruptible power supply (UPS). Non-spring-return actuators have external manual gear release to position damper/valve when actuator is not powered.
  3. Proportional actuators accepts 0 to 10 VDC or 0 to 20 mA control signal and provide 2 to 10 VDC or 4 to 20 mA operating range.
  4. Actuator sized for torque required plus 25 percent; UL or CSA listed; electronic current overload protection.
  5. For system differential pressure control valves, provide fast acting valve actuator with valve open or close time of 30 to 60 seconds.
  6. VAV Actuators: Actuators proportional 24 VAC actuators using a 4 to 20 mA range of control signals; stops automatically at end of travel; include permanently lubricated gear train.
  7. Actuators for emergency generator damper control rated for 350 degree F. maximum operating temperature and capable to drive fully open and close within 15 seconds.
- G. Room Pressure Monitor: Active room pressure monitor and alarm which provides local audio alarm and analog and alarm signals to DDC system. Wall mounted panel with LED differential pressure readout; audible and visual alarm; mute button; range of -0.05 to +0.05-inch WC; accurate to 1 percent of full scale; repeatability plus or minus 1.0 percent of full scale per year, alarm delay ability between 0-30 seconds. Provide door switch to deactivate alarm when space door(s) are open. Input status from BAS to deactivate alarm in unoccupied or shutdown modes. Phoenix Controls APM100.
- H. Duct Mounted Carbon Dioxide Sensor:
1. Duct mounted CO2 sensor consists of infrared sensing element with heated stannic dioxide semiconductor. Operating range 0-2000 ppm plus 50 ppm plus 2 percent of measured value; maximum duct velocity of 1500 fpm; duct mounting kit.
- I. Wall Mounted Space Carbon Dioxide Sensor:
1. Sensor to employ non-dispersive infrared technology. (N.D.I.R.)
  2. Sensor Repeatability: Plus or minus 20 ppm. 0-2000.
  3. Sensor Accuracy: Less than or equal to 75 ppm over 0-1500 ppm range.
  4. Sensor Response Time: Less than 1 minute.
  5. Sensor to employ reference channel design for long-term stability.
  6. Sensor to have field selectable 0-10VDC, or 4-20mA outputs.
  7. Sensor power requirement less than 3W.
  8. Sensor Input Voltage: 20 to 30VAC/DC.
  9. Sensor Operating Temperature Range: 0 degrees C to 50 degrees C.
  10. Sensor to have models for wall mounting or duct mounting.
  11. Sensor to provide at least a 1-year factory warranty from date of purchase.
  12. Sensor to match cover in color and look to temperature sensor.
  13. Sensor to have display.
  14. Manufacturers:
    - a. Telaire
    - b. Vaisala

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c. Veris

- J. Carbon Monoxide Detector:
  - 1. Microprocessor based CO sensor and controller with fan relay, pilot light indicators; comply with UL Standards 2034; self-supervision activates fan if system detects problems; calibration kit for project.
  - 2. Relay to activate fan at sensing 35 ppm CO after 5 minutes. Minimum fan runtime to be 2-1/2 minutes. Relay to activate alarm at sensing 100 ppm CO after 30 minutes. Vulcain Electrochemical Type (Q1).
- K. Occupancy Sensor: Dual technology infrared and ultrasonic sensing device, ceiling or wall mounted, built-in self-adjusting settings, timer settings of 30 seconds to 30 minutes, with manual and automatic modes. Provide multiple devices in parallel when area served is greater than a single device sensing capability. Provide integral power pack, 120 VAC input, 24 VDC output, with manual override switch. Leviton OSC-MOW series.
- L. Relays:
  - 1. Control relays UL listed plug-in type with dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage to be suitable for application.
  - 2. Time delay relays UL listed solid-state plug-in type with adjustable time delay. Delay adjustable plus or minus 200 percent (minimum) from setpoint or as indicated. Contact rating, configuration, and coil voltage to be suitable for application. Provide NEMA 1 enclosure when not installed in local control panel.
- M. Override Timers: Override timers spring-wound line voltage, UL Listed, with contact rating and configuration as required by application. Provide 0-to-6-hour calibrated dial unless otherwise specified. Timer suitable for flush mounting on control panel face and located on local control panels or where shown.
- N. Current Transmitters:
  - 1. AC current transmitters are self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4 to 20 mA two-wire output. Unit range compatible with actual applied span of current value, with internal zero and span adjustment and plus or minus 1 percent full-scale accuracy at 500 ohm maximum burden.
  - 2. Transmitter meets or exceeds ANSI/ISA S50.1 requirements and UL/CSA recognized.
  - 3. Unit split-core type for clamp-on installation on existing wiring.
- O. Current Transformers: AC current transformers UL/CSA recognized and completely encased (except for terminals) in approved plastic material; plus or minus 1 percent accuracy at 5 A full-scale.
- P. Voltage Transmitters: AC voltage; self-powered single-loop (two-wire) type; 4 to 20 mA output with zero and span adjustment; UL/CSA recognized at 600 VAC rating and meet or exceed ANSI/ISA S50.1. Ranges include 100 to 130 VAC, 200 to 250 VAC, 250 to 330 VAC, and 400 to 600 VAC full-scale, adjustable, with plus or minus 1 percent full-scale accuracy with 500 ohm maximum burden.
- Q. Voltage Transformers: AC voltage transformers UL/CSA recognized, 600 VAC rated; built-in fuse protection; suitable for ambient temperatures of 40 degrees F to 130 degrees F; plus or minus 0.5 percent accuracy at 24 VAC and a 5 VA load.
- R. End Switches: Turret head Type SPDT. Schneider Electric/Square D Class 9007, Type C54B2, or approved equivalent.

### 2.13 WIRING AND RACEWAYS

- A. General: Provide copper wiring, plenum cable, and raceways as specified in applicable Sections of Division 26, Electrical.
- B. Insulated wire to be copper conductors, UL labeled for 90 degrees C minimum service.

- C. Field panels and controllers to be supplied by building emergency power system where systems being monitored or controlled are on emergency power.
- D. Run control wiring as follows:
  - 1. Mechanical Rooms: In conduit.
  - 2. Exposed in Building Spaces: In conduit.
  - 3. Concealed in Building Walls and Ceilings: Plenum rated cable.
  - 4. Concealed in Building Ceilings: Plenum rated cable in cable tray.
- E. Field and Subfield Panels: Voltage in panels not-to-exceed 120 volts.
- F. Motor Control Centers: Responsibility for correct voltage of holding coils and starter wiring in pre-wired motor control centers interfacing with automatic controls is included hereunder.
- G. Wiring for BAS systems communications buses two conductor minimum 18 gauge foil-shielded, stranded twisted pair cable rated at 300 VDC or more than 80 degrees C.

#### **2.14 SMOKE DETECTION (FOR PROJECTS WITH A FIRE ALARM SYSTEM)**

- A. See Division 28 for Products.

### **PART 3 - EXECUTION**

#### **3.01 DEMOLITION**

- A. Terminal Devices: Remove terminal sensors, actuators and controls as indicated on drawings and as required to accommodate scope of mechanical work shown on drawings and described in specifications. Remove pneumatic piping and cap with hardware as appropriate. Remove wiring and conduit associated with devices. Do not leave any unused abandoned piping or wiring in space. Remove pneumatic piping, wiring and conduits, including all appurtenances back to the main.
- B. Graphics and Programming: Remove symbols from control system graphics associated with deleted terminal elements. Modify programming code to delete alarms, control loops, etc., associated with deleted terminal devices.

#### **3.02 EXAMINATION**

- A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence.
- B. Notify the Owner's Authorized Representative in writing of conditions detrimental to the proper and timely completion of the work.
- C. Do not begin work until unsatisfactory conditions are resolved.

#### **3.03 CONTROL SYSTEM CHECKOUT AND TESTING**

- A. Testing completed before Owner's Authorized Representative is notified of system demonstration.
- B. Calibrate and prepare for service of instruments, controls, and accessory equipment furnished under this specification.
- C. Verify that control wiring is properly connected and free of shorts and ground faults.
- D. Enable control systems and verify calibration and operation of input and output devices.
- E. Verify that system operation adheres to sequences of operation.
- F. Commissioning and Verification: In addition to commissioning requirements specified elsewhere, provide the following commissioning on the HVAC instrumentation and controls system:
  - 1. Control systems completely commissioned to ensure aspects of the system are operating as intended and at optimum tuning.
  - 2. Wiring connections verified and traced from field device to panel to ensure proper connections.

3. Measured values verified by a hand held calibrated device to validate that value indicated by the control system is in fact the actual measured value.
4. Loops properly tuned to obtain the desired control value. Each loop to be "upset" and put back in control to demonstrate its ability to stabilize quickly.
5. Provide a final point-by-point report submitted that indicates the date of each verification, the results, and initialed on each page by the person performing the reading.

### **3.04 ACCEPTANCE TESTING AND TRAINING**

- A. Site Testing:
  1. Contractor provides personnel, equipment, instrumentation, and supplies necessary to perform testing. Owner or Owner's Authorized Representative will witness and sign off on acceptance testing.
  2. Contractor demonstrates compliance of completed control system with Contract Documents. Using approved test plan, physical and functional requirements of project demonstrated.
- B. Training:
  1. General: Contractor conducts training courses for up to three other designated personnel in operation and maintenance of system. Training manuals provided for each trainee, with two additional copies provided for archival at project site. Manuals include detailed description of subject matter for each lesson. Copies of audiovisuals delivered to Owner. Training day is defined as 8 hours of classroom instruction, including two 15-minute breaks and excluding lunch time, Monday through Friday, during normal first shift in effect at training facility. Notification of any planned training given to Owner's Authorized Representative at least 15 days prior to training.
  2. Operator's Training I: First course taught at supplier's facility for period of one training day. Upon completion, each student should be able to perform elementary operations with guidance and describe general hardware architecture and functionality of system.
  3. Operator's Training II: Second course taught at project site for a period of one training day after completion of contractor's field testing. Course includes instruction on specific hardware configuration of installed system and specific instructions for operating installed system. Upon completion, each student should be able to start system, operate the system, recover system after failure, and describe specific hardware architecture and operation of system.
  4. Operator's Training III: Third course taught at project site for period of one training day no later than six months after completion of the acceptance test. Course will be structured to address specific topics that students need to discuss and to answer questions concerning operation of system. Upon completion, students should be fully proficient in system operation and have no unanswered questions regarding operation of installed system.

### **3.05 COMMUNICATION WIRING**

- A. Follow manufacturer's installation recommendations for communication cabling.
- B. Verify integrity of network following cable installation.
- C. Communication wiring unspliced length when that length is commercially available; labeled to indicate origination and destination data.
- D. Grounding of coaxial cable in accordance with NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

### **3.06 WIRING AND RACEWAYS**

- A. Provide electrical wiring required to control systems specified in this Section. Control and interlock wiring complies with national, state and local electrical codes and Division 26, Electrical of this specification.
- B. Power wiring required for building control panel(s) to be dedicated circuit(s).
- C. Verify location of operator work station with Owner prior to installation.

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- D. NEC Class 1 (line voltage) wiring UL Listed in approved raceway according to NEC and Division 26, Electrical requirements.
- E. Low-voltage wiring meets NEC Class 2 requirements. (Low-voltage power circuits subfused when required to meet Class 2 current limit.)
- F. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in raceway may be used provided that cables are UL listed for intended application.
- G. Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high-voltage wiring and equipment may not be used for low-voltage wiring except for purpose of interfacing (e.g., relays and transformers).
- H. Where Class 2 wiring is run exposed, wiring run parallel along surface or perpendicular to it and tied at 10 foot intervals.
- I. Where plenum cables are used without raceway, support from structural members. Do not support cables with ductwork, electrical raceways, piping, or ceiling suspension systems.
- J. Make wire-to-device connections at terminal block or terminal strip. Make wire-to-wire connections at terminal block.
- K. Maximum allowable voltage for control wiring 24 V. If only higher voltages are available, provide step-down transformers.
- L. Wiring installed as continuous lengths, with no splices permitted between termination points.
- M. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at penetrations.
- N. Include one pull string in each raceway 1-inch or larger.
- O. Control and status relays are to be located in designated enclosures. Enclosures include packaged equipment control panels unless they also contain Class 1 starters.
- P. Install raceway to maintain a minimum clearance of 6-inches from high-temperature equipment (e.g., steam pipes or flues).
- Q. Secure raceways with raceway clamps fastened to structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.
- R. Install insulated bushings on raceway ends and openings to enclosures. Seal top end of vertical raceways.
- S. Flexible metal raceways and liquid-tight, flexible metal raceways not-to-exceed 3-feet in length and be supported at each end. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal raceways to be used.
- T. Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections joined with couplings. Terminations made with fittings at boxes.
- U. Input and output terminations to be labeled at the controller to identify if they are AI, DI, AO, DO, and function (i.e. pump start, OM Sensor).

### **3.07 INSTALLATION OF AUXILIARY CONTROL DEVICES**

- A. General:
  - 1. Install sensors and thermostats in accordance with manufacturer's recommendations.
  - 2. Room sensors and thermostats installed at 48-inches AFF to top of sensor on concealed junction boxes properly supported by wall framing at the locations shown on the Drawings.
  - 3. Low-limit sensors used in mixing plenums installed in a serpentine manner horizontally across duct.

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4. Pipe-mounted temperature sensors installed in wells with heat-conducting fluid in thermal wells.
  5. Install outdoor air temperature sensors on north facing wall or screen, complete with sun shield at designated location.
  6. Chiller or Heat Pump differential pressure sensor: Locate immediately at the chiller or heat pump piping connections, before any fittings or accessories.
- B. Flow Switch: Use correct paddle for pipe diameter. Adjust flow switch in accordance with manufacturer's instructions.
- C. Actuators:
1. General:
    - a. Mount and link control damper actuators according to manufacturer's instructions.
    - b. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
  2. Actuator Mounting for Damper and Valve Arrangements to Comply with the Following:
    - a. Damper Actuators: Do not install in the air stream.
    - b. Use a weather proof enclosure (clear and see through) if actuators are located outside.
    - c. Damper or valve actuator ambient temperature not-to-exceed 122 degrees F through any combination of medium temperature or surrounding air. Provide appropriate air gaps, thermal isolation washers or spacers, standoff legs, or insulation as necessary. Mount per manufacturer's recommendations.
    - d. Actuator cords or conduit to incorporate a drip leg if condensation is possible. Do not allow water to contact actuator or internal parts. Location of conduits in temperatures dropping below dew point to be avoided to prevent water from condensing in conduit and running into actuator.
    - e. Damper mounting arrangements to comply with the following:
      - 1) Furnish and install damper channel supports and sheet metal collars.
      - 2) Jack shafting of damper sections not allowed.
      - 3) Multi-section dampers arranged so that each damper section operates individually. Provide one electronic actuator direct shaft mounted per section.
    - f. Size damper sections based on actuator manufacturers specific recommendations for face velocity, differential pressure and damper type. In general: Damper section not-to-exceed 24 ft-sq. with face velocity 1500 FPM.
    - g. Multiple section dampers of two or more arranged to allow actuators to be direct shaft mounted on the outside of the duct.
    - h. Multiple section dampers of three or more sections wide arranged with a 3-sided vertical channel (8-inch wide by 6-inch deep) within the duct or fan housing and between adjacent damper sections. Vertical channel anchored at the top and bottom to the fan housing or building structure for support. Connect sides of each damper frame to the channels. Holes in the channel to allow damper drive blade shafts to pass through channel for direct shaft mounting of actuators. Face open side of channel downstream of the airflow, except for exhaust air dampers.
    - i. Multiple section dampers to be mounted flush within a wall or housing opening to receive either vertical channel supports as described above or sheet metal stand out collars. Sheet metal collars (12-inch minimum) to bring each damper section out of the wall to allow direct shaft mounting of the actuator on the side of the collar.
- D. Control Damper:
1. Dampers installed in accordance with manufacturer's instructions. Unless specifically designed for vertical blade application, dampers must be mounted with blade axis horizontal.
  2. After installation of low-leakage dampers with seals, caulk between frame and duct or opening to prevent leakage around perimeter of damper.

### **3.08 SMOKE DETECTION (FOR PROJECTS WITH A FIRE ALARM SYSTEM)**

- A. Smoke detector furnished and powered/wired under Division 28, Electronic Safety and Security. Coordinate with fire alarm equipment supplier. Installation of duct smoke detector housing and sampling tube under Division 23, HVAC.
- B. Install smoke detectors in return air systems greater than 2000 CFM.
- C. Install smoke detectors at each story prior to connection to return air riser in systems greater than 15,000 CFM and serving more than one story.

### **3.09 SEQUENCES OF OPERATION AND POINTS LISTS**

- A. Where local energy code dictates certain sequences (such as night setback, night flush, pressure and temperature reset, terminal unit sequences, etc.), the sequences are not necessarily repeated in the documents. It is not the intent of this specification or documentation to reiterate the energy code. Provide energy code mandated sequences and document in sequence of operations submittals at no additional cost to the Owner. Provide required points to achieve the appropriate sequences.
- B. See control diagrams and sequences on drawings.
- C. Variable Frequency Drives: For a VFD dependent on an external input for its output setting (e.g., the VFD gets "Frequency" as an input), loss of that external input to result in the VFD holding its last value. If the VFD is running its own PID loop and the external input to the VFD is a setpoint (e.g. duct static pressure setpoint), the VFD to hold the last setpoint. If the VFD loses its process variable (e.g. duct static pressure), the VFD to go to its minimum speed setting.
- D. Except as specified otherwise, throttling ranges, proportional bands, and cycle differentials to be centered on the associated setpoint. Modulating feedback control loops to include the capability of having proportional, integral, and derivative action. Unless the loop is specified "proportional only" or "P+I", Contractor to apply appropriate elements of integral and derivative gain to each control loop to result in stable operation, minimum settling time and maintain the primary variable within the specified maximum allowable variance.
- E. Provide a real time clock and schedule controller with sufficient scheduling capability to schedule required controllers and sequences. Schedule functionality may reside in a controller. If a controller is used, document scheduling functionality including names and types on controller points list submittal. Set up initial schedules in coordination with Owner.
- F. Scheduling Terminology: When air handlers are scheduled throughout the day, the following defines the terminology used:
  - 1. Occupied Period: Period of time when the building is in use and occupied. Confirm schedule with Owner. Exclude all national holidays. Generally systems will be fully operational throughout this period and ventilation air to be continuously introduced. Space temperature setpoints will generally be in the "normal" range of 68 degrees to 78 degrees F.
  - 2. Unoccupied period: Period of time when the building or zone is not in use and unoccupied. Ventilation air not to be introduced.
  - 3. Preoccupancy Period: Time prior to the Occupied period when the systems are returning the space temperatures from setback to "normal" or occupied setpoints (warm-up and cool-down). Ventilation air shall not be introduced unless outside air conditions permit free-cooling or to support a pre-occupancy purge sequence. Time period to be determined by an optimum start strategy unless otherwise specified.
  - 4. Setback Period: Setback will typically start with the end of the occupied period and end with the start of the preoccupancy period, however it shall be provided with its own schedule. Generally systems will be off except to maintain a "setback" temperature, economization may be enabled to maintain "setback" cooling setpoint when applicable.
- G. Where any sequence or occupancy schedule calls for more than one motorized unit to start simultaneously, the BAS start commands to be staggered by 5 second (adj.) intervals to



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minimize inrush current.

- H. Wherever a value is indicated as adjustable (adj.), it shall be modifiable, with the proper password level. For these points, it is unacceptable to have to modify programming statements to change the setpoint.
- I. When a power failure is detected in any phase, the BAS start commands to be retracted immediately from electrically powered units served by the failed power source. If the associated controller is powered by normal or emergency power, it may monitor its own power source as an indication of power status. If the controller is powered by uninterruptible power supply (UPS), or if it is not capable of monitoring its own power for use in sequences, provide at least one voltage monitor (three phase when applicable) per building. When the BAS detects that normal or emergency power has been restored, all equipment for which the BAS start command had been retracted to be automatically restarted in an orderly manner on staggered 5 second intervals to minimize inrush current.
- J. Where reset action is specified in a sequence of operation, but a reset schedule is not indicated on the drawings, employ one of the following methods:
  - 1. Determine a fixed reset schedule to result in stable operation and maintain the primary variable within the specified maximum allowable variance.
  - 2. Use a floating reset algorithm which increments the secondary variable setpoint (setpoint of control loop being reset) on a periodic basis to maintain primary variable setpoint. The recalculation time and reset increment to be chosen to maintain the primary variable within the specified maximum allowable variance.
  - 3. Primary variable to control the devices directly using a PID feedback control loop without resetting the secondary variable. However, the control devices to still modulate as necessary to maintain upper and lower limits on the secondary variable. Proportional band, integral gain, and derivative term to be selected to maintain the primary variable within the specified maximum allowable tolerance while minimizing overshoot and settling time. Gain prior approval for implementing this method of reset.
- K. Where a supply air temperature or duct pressure setpoint is specified to be reset by the space temperature of the zones calling for the most cooling/heating, employ the following method:
  - 1. Use a floating reset algorithm which increments the secondary variable (e.g., supply air temperature or duct pressure) setpoint on a periodic basis to maintain primary variable (e.g., space temperature) setpoint. The reset increment to be determined by the quantity of "need heat" or "need cool" requests from individual SCU's. A SCU's "need heat" virtual point to activate whenever the zone's space temperature falls below the currently applicable (occupied or unoccupied) heating setpoint throttling range. A SCU's "need cool" virtual point to activate whenever the zone's space temperature rises above the currently applicable (occupied, unoccupied, or economy) cooling setpoint throttling range. The recalculation time and reset increment to be chosen to maintain the primary variable within the specified maximum allowable variance while minimizing overshoot and settling time. Reset range maximum and minimum values to limit the setpoint range.
- L. Where a supply air temperature, duct pressure, or differential water pressure setpoint is specified to be reset by valve or damper position of the zone or zones calling for the most cooling/heating, the following method to be employed:
  - 1. A floating reset algorithm to be used which increments the secondary variable (e.g., supply air temperature, pipe or duct pressure) setpoint on a periodic basis to maintain primary variable (e.g., cooling valve, heating valve, damper position) setpoint of 85 percent open. The reset increment to be calculated based on the average position of the quantity of the worst (most open valve/damper) zone(s) as specified. The recalculation time, reset increment and control device position influence to be chosen to maintain the primal variable within the specified maximum allowable variance while overshoot and settling time. The BAS analog output value to be acceptable as indicating the position of the control device.

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2. Alternatively to continuously calculating the average of the quantity of worst valve/damper positions, a method similar to the one described above may be employed whereby the “need heat” or “need cool” virtual point to increment by one unit each time a zone’s valve/damper position rises to greater than 95 percent. The quantity of “need heat” or “need cool” points to then be the basis for reset.
- M. Where “prove operation” of a device (generally controlled by a digital output) is indicated in the sequence, it shall require that the BAS, after an adjustable time delay after the device is commanded to operate (feedback delay), confirm that the device is operational via the status input. If the status point does not confirm operation after the time delay or anytime thereafter for an adjustable time delay (debounce delay) while the device is commanded to run, an alarm to be enunciated audibly. Upon failure, run command to be removed and the device to be locked out until the alarm is manually acknowledged unless specified otherwise.
- N. BAS to provide for adjustable maximum rates of change for increasing and decreasing output from the following analog output points:
  1. Speed control of variable speed drives
  2. Control Reset Loop
  3. Valve Travel Limit
- O. Wherever a value is indicated to be dependent on another value (i.e., setpoint plus 5 degrees F) BAS to use that equation to determine the value. Simply providing a virtual point that the operator must set is unacceptable. In this case three virtual points to be provided. One to store the parameter (5 degrees F), one to store the setpoint, and one to store the value which is the result of the equation.
- P. Trend points as identified in the points list. Trends to be grouped system specific and setup in two-axis (x,y) graphical format that display object values relative to time. Setup trends to record data in 5 minute increments.
- Q. **Air Handling Unit (HP-X):**
  1. General: Unit to operate under following modes: Occupied, Shutdown and Unoccupied. H-O-A switches on graphics screens or text dialog boxes may override on/off equipment.
  2. Equipment:
    - a. Air Handling Units: HP-X
  3. Occupied Mode:
    - a. Supply fan runs continuously.
    - b. Space temperature sensor signals controller which sequence DX operation and stages of electric heating to maintain space temperature setpoint.
  4. Shutdown Mode:
    - a. Supply fan off.
    - b. DX and electric heater off.
  5. Unoccupied Mode:
    - a. Night Setback and Setup: Supply fan operates when any space temperature drops to 60 degrees F or below or rises to 85 degrees F or above in designated zones. Maintain fan operation until space temperature rises to 63 degrees F (heating) or 82 degrees F (cooling). When supply fan operates.
  6. Warm-up Control: Optimal start program initiates warm-up control. Supply fan operates during warmup. When space temperature reaches 70 degrees F for 30 minutes, switch to occupied mode.
  7. Unoccupied Mode Override: For each unit upon receiving “override” signal from designated space temperature sensors, controller changes space to occupied mode for period of 2 hours (adjustable).
  8. Alarms/Safeties:
    - a. Provide interface with fire alarm system. During fire alarm mode shutdown air handling units.
    - b. During fire mode smoke dampers close by Division 26, Electrical.

- c. Current transformer located in fan power circuit signals controller in event of fan/control failure. An alarm generated.

9. Air Handling Unit (HP-X) Points List:

Points List	Analog In	Analog Out	Digital In	Digital Out	Alarms	Trend
Supply Fan Start/Stop				X		
Supply Fan Status (Current Transformer)			X		Fail	X
Zone Temp	X					X
DX Staging		X				X
Electric Heat Stages		X				X
Fire Alarm Shutdown			X			

R. **General Exhaust Fan (CV):**

- Fan controller receives signal from building controller, which initiates occupied or unoccupied mode. During occupied mode open isolation damper and run fan continuously. During unoccupied mode close isolation damper and fan off.
- Current transformer signals controller which generates alarm when fan/controller fails to operate.
- General Exhaust Fan (CV) Points List:

Points List	Analog In	Analog Out	Digital In	Digital Out	Alarms	Trend
Exhaust Fan Start/Stop				X		
Exhaust Fan Status (Current Transformer)			X		Fail	X
Damper Open/Close				X		

S. **Mini-Split AC Unit/Heat Pump:**

- Fan coil and condensing unit cycle compressor to maintain space temperature of 75F cooling and 70F heating (where heating is scheduled).
- Unit controlled via hard-wired wall-mounted thermostat.
- Points below are for temperature monitoring of space.
- Mini-Split AC Unit/Heat Pump Points List:

Points List	Analog In	Analog Out	Digital In	Digital Out	Alarms	Trend
Zone Temp	X				Temp > 80F	X

T. **Combination Fire Smoke Dampers (FSD):**

- Dampers closed upon receiving signal from fire alarm system, or from central controller.
- Dampers closed when their corresponding fan is not operating.

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3. Dampers open when fan systems are operating, unless overridden by fire alarm system.
4. Provide LED indicators in ceiling for each FSD, indicating open, not open, status
5. Combination Fire Smoke Dampers (FSD) Points List:

<b>Points List</b>	<b>Analog In</b>	<b>Analog Out</b>	<b>Digital In</b>	<b>Digital Out</b>	<b>Alarms</b>
Damper Open/Close				X	
Fire Alarm Signal			X		

**END OF SECTION**

**SECTION 232113  
HVAC PIPING**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Equipment Drains and Overflows
  - 2. Unions
  - 3. Refrigerant Piping

**1.02 RELATED SECTIONS**

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Welding Certificates: Copies of certificates for welding procedures and personnel.
  - 2. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:
    - a. Test procedures used.
    - b. Test results that comply with requirements.
    - c. Failed test results and corrective action taken to achieve requirements.
  - 3. Grooved couplings, fittings, valves, and specialties: Show grooved joint couplings and fittings on Shop Drawings and product submittals, and specifically identify with the applicable coupling style number.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Installer Qualifications: Company specializing in performing work of the type specified in this Section, with documented experience.
  - 2. Welder Qualifications: Certify in accordance with ASME (BPV IX).
  - 3. ASME Compliance: Comply with ASME B31.9 "Building Services Piping" for materials, products, and installation. Provide safety valves and pressure vessels with the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 01.
  - 4. Grooved couplings, fittings, valves, and specialties: Provide all grooved couplings, fittings, valves, and specialty products from a single manufacturer. Utilize only grooving tools from the same manufacturer as the grooved components. Date-stamp all castings used for couplings housings, fittings, or valve and specialty bodies for quality assurance and traceability.
  - 5. Refrigerant Piping:
    - a. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX "Welding and Brazing Qualifications."
    - b. ASHRAE Standard: Comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."
    - c. ASME Standard: Comply with ASME B31.5, "Refrigeration Piping."

- d. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Nonelectrical" or UL 429 "Electrically Operated Valves."

#### **1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

### **PART 2 - PRODUCTS**

#### **2.01 EQUIPMENT DRAINS AND OVERFLOWS**

- A. Copper Tube: ASTM B 88 (ASTM B 88M), Type L (B), drawn.
  - 1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
  - 2. Joints: Solder, lead free, ASTM B 32, HB alloy (95-5 tin-antimony), or tin and silver.
  - 3. Joints: Brazed, AWS A5.8, Classification BAg-1 (silver). Pipes 2-1/2-inch or larger or piping routed over computer rooms, telecommunications rooms, and electrical rooms.

#### **2.02 UNIONS**

- A. Unions for Pipe 2-inches and Under:
  - 1. Copper Pipe: Bronze, soldered joints, ASME B16.22.
- B. Dielectric Connections: Provide dielectric waterway or brass nipple fitting with threaded ends. Dielectric unions are not allowed.

#### **2.03 REFRIGERANT PIPING**

- A. Piping:
  - 1. Copper Tube: ASTM B 280, Type ACR, annealed-temper tube, clean, dry and capped.
    - a. Fittings: ASME B16.22 wrought copper.
    - b. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy (15 percent Silver).
- B. Valves:
  - 1. Manufacturers:
    - a. Hansen Technologies Corporation
    - b. Henry Technologies
    - c. Danfoss Flomatic
    - d. Substitutions: See Section 23 00 00, HVAC Basic Requirements, Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
  - 2. Packaged Ball Valves:
    - a. Two piece bolted forged brass body with Teflon ball seals and copper tube extensions, brass seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of and maximum temperature of 300 degrees F.

### **PART 3 - EXECUTION**

#### **3.01 GENERAL INSTALLATION REQUIREMENTS**

- A. Install per manufacturer's written instructions and requirements.
- B. Preparation:
  - 1. Ream pipe and tube ends. Remove burrs.
  - 2. Remove scale and dirt on inside and outside before assembly.
  - 3. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- C. Above Grade Piping Installation:
  - 1. Install per manufacturer's written instructions and requirements.
  - 2. Route piping in orderly manner, parallel to building structure, and maintain gradient.
  - 3. Install piping to conserve building space and to avoid interference with use of space.

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4. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
  5. Sleeve pipe passing through partitions, walls and floors allowing adequate space for pipe insulation.
  6. Slope piping at 0.2 percent upward in direction of flow and arrange to drain at low points.
  7. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
  8. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
  9. Drawings are diagrammatic and do not necessarily show top connections in all cases. Install branch connections to mains using tee fittings in main, with takeoff coming out of the top unless trade coordination conditions preclude it.
  10. Anchor piping for proper direction of expansion and contraction.
  11. Inserts:
    - a. Provide inserts for placement in concrete formwork.
    - b. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
    - c. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4-inches.
    - d. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
    - e. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.
  12. Pipe Hangers and Supports:
    - a. Install in accordance with Division 23, HVAC, Hangers and Supports.
    - b. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
    - c. Place hangers within 12-inches of each horizontal elbow.
    - d. Use hangers with 1-1/2-inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
    - e. Support vertical piping at top, bottom, and not less than every other floor. Support riser piping independently of connected horizontal piping.
    - f. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
    - g. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting.
    - h. Provide copper plated hangers and supports for copper piping.
    - i. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
  13. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
  14. Provide access where valves and fittings are not exposed.
  15. Use eccentric reducers to maintain top of pipe level.
  16. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
  17. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting.
- D. Field Quality Control:
1. Leave joints, including welds, uninsulated and exposed for examination during test.
  2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
  3. Flush system with clean water. Clean strainers.
  4. Isolate equipment from piping. If a valve is used to isolate equipment, provide closure capable of sealing against test pressure without damage to valve. Install blinds in flanged

- joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
  6. Perform the following tests on hydronic piping:
    - a. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
    - b. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.
    - c. Check expansion tanks to determine that they are not air bound and that system is full of water.
    - d. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure not-to-exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping."
    - e. After hydrostatic test pressure has been applied for at least four hours, examine piping, joints and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
    - f. Prepare written report of testing.
- E. Flushing and Cleaning of Piping Systems:
1. Clean piping systems thoroughly. Purge pipe of construction debris and contamination before placing the piping systems in service. Provide temporary connections for cleaning, purging, and circulating fluids through the piping system.
  2. Use temporary strainers and temporary pumps that can create fluid velocities up to 10 feet per second to flush and clean the piping systems. Do not use Owner's permanent strainers to trap debris during pipe flushing operations. Fit the temporary construction strainers with a line size blowoff valve.

### **3.02 REFRIGERANT PIPING INSTALLATION**

- A. Install systems in accordance with ASHRAE Standard 15.
- B. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.
- C. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.
- D. Flood piping system with nitrogen when brazing.
- E. Follow ASHRAE Standard 15 procedures for charging and purging of systems and for disposal of refrigerant.
- F. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.
- G. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
- H. Fully charge completed system with refrigerant after testing.
- I. Field Quality Control:
  1. Test refrigeration system in accordance with ASME B31.5.
  2. Pressure test system with dry nitrogen to 200 PSI. Perform final tests at 27-inches vacuum and 200 PSI using electronic leak detector. Test to no leakage.

**END OF SECTION**



**SECTION 233100  
HVAC DUCTS AND CASINGS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Ductwork, Joints and Fittings
  - 2. Insulated Flexible Duct
  - 3. Drain Pans
  - 4. Ductwork Joint Sealers and Sealants

**1.02 RELATED SECTIONS**

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
  - 1. Section 23 05 29, Hangers and Supports for HVAC Piping, Ductwork and Equipment.
  - 2. Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Welding Certificates
  - 2. Field Quality Control Reports

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. NFPA Compliance:
    - a. NFPA 90A Installation of Air Conditioning and Ventilating Systems.
    - b. NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.
  - 2. Comply with SMACNA's HVAC Duct Construction Standards - Metal and Flexible for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Provide sheet metal materials free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
  - 3. Provide ductwork pressure testing and leakage testing per Section 23 05 93, Testing, Adjusting and Balancing for HVAC.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

**1.07 SYSTEM DESCRIPTION**

- A. Duct system design, as indicated, has been used to select size and type of air-moving and distribution equipment and other air system components. Duct design is generally diagrammatic and is not meant to be scaled. Major changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

## **PART 2 - PRODUCTS**

### **2.01 DUCTWORK, JOINTS AND FITTINGS**

- A. Manufacturers:
  - 1. Ductmate
  - 2. Lindab Inc.
  - 3. Nexus Inc.
  - 4. SEMCO
  - 5. United McGill Corporation
  - 6. Ward Industries
- B. Materials:
  - 1. Galvanized Steel Ducts: Hot-dipped galvanized steel sheet, lock-forming quality, ASTM A 653/A 653M FS Type B, with G90/Z275 coating, minimum 26 gauge except where heavier material is specified. Ducts to have mill phosphatized finish for surfaces exposed to view.
  - 2. Aluminum Ducts: ASTM B 209 (ASTM B 209M); aluminum sheet, alloy 3003-H14.  
Aluminum Connectors and Bar Stock: Minimum 24 gauge except where heavier material is specified; alloy 6061-T651 or of equivalent strength with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts with liquid-tight joints when containing condensate vapor or liquids in suspension.
  - 3. Stainless Steel: Fabricated in accordance with ASTM A167 and A480 with liquid-tight joints when containing condensate vapor or liquids in suspension.
- C. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
  - 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
  - 2. Deflection: Duct systems not-to-exceed deflection limits according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible.
  - 3. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
- D. Formed-On Flanges: construct according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible, Figure 1-4, using corner, bolt, cleat, and gasket details.
  - 1. Duct Size: Maximum 30-inches wide and up to 2-inch wg pressure class.
  - 2. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.
  - 3. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19-inches and larger and 0.0359-inch thick or less, with more than 10 SF of nonbraced panel area unless ducts are lined.
- E. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of material specified in this Section according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible.
  - 1. Ducts up to 20-inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
  - 2. Ducts 21- to 72-inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
  - 3. Ducts Larger than 72-inches in Diameter: Companion angle flanged joints per SMACNA HVAC Duct Construction Standards-Metal and Flexible, Figure 3-2.
  - 4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
- F. 90-Degree Tees and laterals and Conical Tees: Fabricate to comply with SMACNA's HVAC Duct Construction Standards-Metal and Flexible, with metal thicknesses specified for longitudinal-seam straight ducts.

- G. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.
- H. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows to be 1.5 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
  - 1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's HVAC Duct Construction Standards-Metal and flexible, unless otherwise indicated.
  - 2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg (minus 500 to plus 500 Pa):
    - a. Ducts 3- to 36-inches in Diameter: 0.034-inch .
    - b. Ducts 37- to 50-inches in Diameter: 0.040-inch.
    - c. Ducts 52- to 60-inches in Diameter: 0.052-inch.
    - d. Ducts 62- to 84-inches in Diameter: 0.064-inch.
  - 3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg:
    - a. Ducts 3- to 26-inches in Diameter: 0.034-inch.
    - b. Ducts 27- to 50-inches in Diameter: 0.040-inch.
    - c. Ducts 52- to 60-inches in Diameter: 0.052-inch.
    - d. Ducts 62- to 84-inches in Diameter: 0.064-inch.
  - 4. 90-Degree, Two-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
  - 5. Round Elbows:
    - a. 8-inches and Less in Diameter: Fabricate die-formed elbows for 45 and 90-degree elbows and pleated elbows for 30, 45, 60 and 90 degrees only. Fabricate nonstandard bend-angle configurations or non-standard diameter elbows with gored construction.
    - b. 9 through 14-inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60 and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
    - c. Larger than 14-inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
  - 6. Die-Formed Elbows for Sizes through 8-inches in Diameter and Pressures 0.040-inch thick with two-piece welded construction.
  - 7. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
  - 8. Pleated Elbows for Sizes through 14-inches in Diameter and Pressures through 10-inch wg (2500 Pa): 0.022-inch.
  - 9. Not acceptable:
    - a. Corrugated or flexible metal duct.
    - b. Adjustable elbows.

## **2.02 INSULATED FLEXIBLE DUCT**

- A. Manufacturers:
  - 1. ATCO
  - 2. Flexmaster
  - 3. J.P. Lamborn Co.
  - 4. Hart and Cooley
- B. Construction: Standard factory fabricated product. Inner wall: Impervious vinyl or chlorinated polyethylene, permanently bonded to a vinyl or zinc-coated spring steel helix.

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- C. Insulation: Fiberglass blanket insulation covered by an outer wall of vinyl or fiberglass-reinforced metalized vapor barrier.
- D. Listing: UL 181 listed Class 1 flexible air duct material. Overall thermal transmission: No more than 0.25 BTU/in or hr/sq. degrees F at 75 degrees F differential, per ASTM C335.
- E. Vapor transmission value no more than 0.10 perm, per ASTM E96.
- F. Pressure Rating: 4-inch wg positive pressure and 1-inch wg negative pressure.
- G. Performance Air Friction Correction Factor: 1.3 maximum at 95 percent extension. Working air velocity: Minimum 2000 FPM.
- H. Flame Spread Rating: No more than 25.
- I. Smoke Development Rating: No more than 50 as tested per ASTM E84.
- J. Insertion Loss: Minimum attenuation of 29 DB for 10-foot straight length at 8-inch diameter at 500 Hz.

### **2.03 DRAIN PANS**

- A. Primary Drain Pans: Stainless Steel, Fabricated in accordance with ASTM A167 and A480.
- B. Secondary Drain Pans: Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A 653/A 653M FS Type B, with G90/Z275 coating.

### **2.04 DUCTWORK JOINT SEALERS AND SEALANTS**

- A. Manufacturers:
  - 1. Ductmate
  - 2. Duro Dyne
  - 3. Hardcast
  - 4. United McGill Corporation
  - 5. Vulkem
  - 6. Foster
  - 7. Childer
- B. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
- C. Low Emitting Materials Requirement: Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management District (SCAQMD) Rule #1168.
- D. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure and leakage class of ducts.
- E. Surface Burning Characteristics: Flame spread of zero, smoke developed of zero, when tested in accordance with ASTM E 84.
- F. Water Based Sealant for Brush-On Application: Flexible, adhesive sealant, resistant to UV light, UL-181A, and UL-181-B listed, complying with NFPA requirements for Class 1 ducts. Min. 69 percent solids, nonflammable. Hardcast Versa-Grip 181; Childers CP-146; Foster 32-19 for SMACNA 1/2, 1, 2, 3, 4, 6, and 10-inch WG duct classes, and SMACNA Seal Class A, B, or C.
- G. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use O.
- H. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.
- I. Polyurethane Sealant: General-purpose, exterior use, non-brittle sealant for gunned application. Vulkem 616 or equal.

**PART 3 - EXECUTION**

**3.01 GENERAL INSTALLATION REQUIREMENTS**

- A. General: Use the following pressure seal, and leakage class(es) in design of ductwork specified in this section unless otherwise noted on Drawings.

<b>SYSTEM</b>	<b>PRESSURE CLASS (Inches of Water)</b>	<b>SEAL CLASS</b>	<b>LEAKAGE CLASS ROUND DUCTS</b>	<b>LEAKAGE CLASS RECTANGULAR DUCTS</b>
Low pressure (downstream of terminal unit)	+ 1-inch	A	3	6
Return and exhaust	0.5-inch more negative than return/exhaust fan pressure or -2-inch pressure class, whichever is more negative.	A	3	6
Lab low pressure exhaust (upstream of lab valve/terminal unit)	-1-inch	A	3	6

- B. Ductwork Installation:

1. General: Install entire duct system in accordance with drawings, Specifications, and latest issues of local Mechanical Code, NFPA 90A, and SMACNA Duct Construction Manual. At Contractor's option, rectangular ductwork may be resized to maintain an equivalent air velocity and friction rate, while maintaining a maximum aspect ratio of 3. Remove markings and tagging from ductwork exterior surface in mechanical rooms and other locations where ductwork is exposed.
2. The duct layout shown on the Contract Drawings is diagrammatic in nature. Coordinate the ductwork routing and layout, and make alterations to the ductwork routing and layout to eliminate physical interferences. Where deviations in the ductwork routing as shown in the Contract Drawings are required, alterations may be made so as not to compromise the air flow, pressure drop, and sound characteristics of the duct fitting or duct run as shown on the Contract Drawings. In the event Architect determines that the installed ductwork is inconsistent with the above mentioned criteria, remove and replace at no additional cost to the Owner.
3. Install ducts with fewest possible joints.
4. Install fabricated fittings for changes in directions, size, shape, and for connections.
5. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12-inches, with a minimum of 3 screws in each coupling.
6. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
7. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

8. Install ducts with a clearance of 1-inch, plus allowance for insulation thickness. Allow for easy removal of ceiling tile.
  9. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
  10. Coordinate layout with suspended ceiling, air duct accessories, lighting layouts, and similar finish work.
  11. Electrical and IT Equipment Spaces: route ducts to avoid passing through transformer vaults, electrical equipment spaces, IDF/MPOE rooms, and enclosures.
  12. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2-inches.
  13. Fire- and Smoke-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire, smoke or combination fire and smoke dampers as governed by Building Code and AHJ, including sleeves, and firestopping sealant.
  14. Install ducts with hangers and braces designed to withstand, without damage to equipment, seismic force required by applicable building codes. Reference SMACNA's Seismic Restraint Manual: Guidelines for Mechanical Systems, Mason Seismic Restraint and Support Systems.
  15. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's Duct Cleanliness for New Construction Advanced Level.
  16. Paint interiors of metal ducts, that do not have duct liner, for 24-inches upstream of registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible duct material.
  17. Install ductwork in the location and manner shown and detailed. Review deviations required by job conditions with Architect prior to any fabrication. Provide fittings for construction per SMACNA.
  18. Install flexible ductwork to limit sag between support hangers to 1/2-inch per foot of spacing support.
- C. Flanged Take-Offs:
1. Install at branch takeoffs to outlets using round or flex duct.
  2. Flanged take-offs secured with minimum 8-inch screw spacing (three screws minimum).
  3. Provide ductwork taps and branches off of main ducts at 45 degrees whether shown on Drawings or not (drawings are diagrammatic).
- D. Cleaning:
1. Clean duct systems with high power vacuum machines. Protect equipment that could be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.
  2. Grille and Exposed Duct Cleaning:
    - a. After completion of ductwork installation, operate each fan system (excluding exhaust fans) for a minimum of 30 minutes prior to installation of ceiling grilles and diffusers. After grilles and diffusers are installed, clean out accumulation of particles from grilles and diffusers prior to acceptance.
    - b. Clean exterior surface of ducts exposed to public view of chalk, pencil and pen marks, labels, sizing tags, dirt, dust, etc., so that upon completion of installation, ducts are left in clean and unblemished manufactured conditions.
    - c. Exposed duct and grilles to remain free of dust entrained streaks due to leakage at joints and grille connections during warranty period. Clean leaks, seal and refinish to match existing if visible streaks develop.

### **3.02 DUCTWORK, JOINTS AND FITTINGS INSTALLATION**

- A. Duct Materials - Applied Locations:

1. General: Use the following materials in design of ductwork specified in this Section unless otherwise noted on the Drawings.

Location or Application	Material
Supply, Return, Transfer, and Exhaust - Low Pressure (downstream of terminal units)	Single Wall, Galvanized Steel
Supply, Return, and Exhaust - Medium Pressure (upstream of terminal units)	Single Wall, Galvanized Steel
General Exhaust Branch Serving Air Inlet in Shower Room or Toilet Room with Shower	Single Wall, Aluminum or Type 304 Stainless Steel

- B. Ductwork Installation:
  1. Fabricate radius elbows with centerline radius not less than 1-1/2 duct diameters.
  2. Do not install duct size transition pitch angles which exceed 30 degrees for reductions in duct size in the direction of airflow, and 15 degrees for expansions in duct size in the direction of airflow.
  3. Install fixed turning vanes in square throat rectangular elbows and in tees.
  4. Fabricate duct turns with the inside (smallest) radius at least equal to the duct width (supply ducts) and 1.5 times radius (return and exhaust ducts). Where necessary, square elbows may be used, with maximum available inside radius and with fixed turning vanes. In healthcare settings such as hospitals and medical office buildings, square elbows and turning vanes allowed on supply ductwork only.

### 3.03 INSULATED FLEXIBLE DUCT INSTALLATION

- A. Provide sheet metal plenum or rigid elbow and connect to diffusers and grilles with ductwork connections. Refer to Drawings for more information. Provide straight section of flexible duct with minimum length of 2-feet and maximum length of 5-feet and connect to sheet metal plenums and rigid elbows connected to diffusers and grilles, unless noted otherwise.
  1. Provide round neck grilles/diffusers or square-to-round transitions. Flexible duct connections directly to diffuser and grilles is not allowed.
  2. Flexible duct allowed in concealed spaces above lay-in ceilings only.

### 3.04 DRAIN PANS INSTALLATION

- A. Install where shown on Drawings. Drain provided by Division 22, Plumbing. Provide drain (sized per code) connection from each drain pan and pipe to nearest floor drain through trap and 10-inch air gap. Drain pans over 6-feet in length require drain connections from both ends. Pitch drain pans in direction of air flow and to drain. Support secondary drain pan independently from equipment.

### 3.05 DUCTWORK JOINT SEALERS AND SEALANTS INSTALLATION

- A. Joints and Seam Joint Sealing:
  1. Seal duct seams and joints according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible, for duct pressure class indicated.
  2. Seal transverse joints, longitudinal seams and duct wall penetrations including screw, fastener, pipe, rod, and wire.
  3. Seal ducts before external insulation is applied.
  4. Tape joints of PVC coated metal ductwork with PVC tape.
  5. Fasteners such as sheet-metal screws, machine screws or rivets to be cadmium plated.
  6. Rectangular Ductwork: Where intermediate joint reinforcement is required for duct of negative pressure class, pre-drill stiffening flange and provide fastener maximum 8-inches on center. Where retaining flanges are welded to duct wall, paint welds with zinc coating.
  7. Single Wall Round Ductwork: Joint to incorporate beaded slip collar with minimum #8 sheet metal screws 8-inches on center. Seal ductwork as specified in this Section.
  8. Seal joints and seams. Apply sealant to make end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

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9. Double Wall Round Ductwork: Joint to incorporate beaded slip collar or flanged connection, with minimum #8 sheet metal screws 8-inches on center. Seal ductwork as specified in this Section.
10. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
11. Provide openings in ductwork where required to accommodate thermometers and control devices. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
12. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities as well as Code required clearances.

**END OF SECTION**



**SECTION 233300  
AIR DUCT ACCESSORIES**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Sheet Metal Materials
  - 2. Backdraft Dampers
  - 3. Dampers
  - 4. Concealed Damper Hardware
  - 5. Access Doors
  - 6. Duct Test Holes
  - 7. Combination Fire and Smoke Dampers
  - 8. Control Dampers
  - 9. Turning Vanes
  - 10. Flexible Connectors

**1.02 RELATED SECTIONS**

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Manufacturer's catalog data and fabrication/installation drawings for each factory fabricated duct accessory. Include leakage, pressure drop and maximum back pressure data.
  - 2. Shop Drawings: Indicate air duct accessories.
  - 3. Manufacturer's installation instructions: Provide instructions for each factory fabricated duct accessory.
  - 4. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    - a. See Division 01, General Requirements, Product Requirements for additional provisions.
    - b. Extra Fusible Links: One of each type and size.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this Section, with minimum five years of documented experience.
  - 2. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
  - 3. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
  - 4. AMCA 511 - Certified Ratings Program for Air Control Devices.
  - 5. AMCA 611, latest edition - Certified Ratings Program - Product Rating Manual for Airflow Measurement Stations.
  - 6. AMCA 610, latest edition - Laboratory Methods of Testing Airflow Measurement Stations for Performance Rating.

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7. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
8. NFPA 92A - Smoke-Control Systems.
9. NFPA 92B - Smoke Control Systems in Atria, Covered Malls and Large Areas.
10. NFPA 101 - Life Safety Code.
11. UL 555 - Standard for Safety; Fire Dampers.
12. UL 555S - Standard for Safety; Leakage Rated Dampers for Use in Smoke Control Systems.

#### **1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

### **PART 2 - PRODUCTS**

#### **2.01 SHEET METAL MATERIALS**

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M. Galvanizing: 1-1/4 ounces per square foot total both sides; ducts to have mill-phosphatized finish for surfaces exposed to view.
- C. Stainless Steel: ASTM A 480/A 480M.
- D. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36-inches or less; 3/8-inch minimum diameter for lengths longer than 36-inches.

#### **2.02 BACKDRAFT DAMPERS**

- A. Manufacturers:
  1. Air Balance
  2. Cesco
  3. Greenheck
  4. Nailor
  5. Ruskin
- B. Basis-of-Design: Ruskin CB D6.
- C. Description: Multiple-blade gravity balanced with center pivoted blades with sealed edges, assembled in rattle free manner with 90-degree stop, adjustment device to permit setting for varying differential static pressure.
- D. Frame: 0.125-inch thick 6063-T5 extruded aluminum channel with galvanized steel braces at mitered corners. Provide mounting flange.
- E. Blades: Single piece, overlap frame, parallel action, horizontal orientation, minimum 0.07-inch 6063-T5 extruded aluminum material, maximum 6-inch width.
- F. Bearings: Corrosion-resistant synthetic, formed as single piece with axles.
- G. Blade Seals: Extruded vinyl, mechanically attached to blade edge.
- H. Blade Axles: Corrosion-resistant, synthetic formed as single piece with bearings, locked to blade.
- I. Tie Bars and Brackets: Galvanized steel.
- J. Return Spring: Adjustable tension.
- K. Damper Capacity:
  1. Closed Position: Maximum back pressure of 16-inches water gauge.

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2. Open Position: Maximum air velocity of 2,500-feet per minute.
- L. Counterbalances: Adjustable zinc plated steel weights mechanically attached to blade. Must be capable of operating over wide range of pressures.
- M. Finish: Mill aluminum.
- N. Temperature Rating: -40 degrees F to 200 degrees F.
- O. Operation of Blade:
  1. Start to Open: 0.01-inch wg
  2. Fully Open: 0.05-inch.
- P. Pressure Drop: Maximum 0.15-inch wg at 1,500-feet per minute through 24-inch by 24-inch damper.
- Q. Factory Sleeve: Minimum 20 gauge thickness, 12-inches in length.
- R. Screen: At outdoor intake or discharge. 1/4-inch aluminum.

### 2.03 DAMPERS

- A. Manufacturers:
  1. Air Balance
  2. Cesco
  3. Greenheck
  4. Nailor
  5. Ruskin
- B. Basis-of-Design:
  1. Rectangular ductwork for velocities and pressures up to 1,500 fpm and 2.5-inch wg, respectively: Ruskin MD-35.
  2. Rectangular ductwork for velocities and pressures up to 3,000 fpm and 4-inch wg, respectively: Ruskin CD-60.
  3. Round ductwork for velocities and pressures up to 3,000 fpm and 4-inch wg, respectively: Ruskin CDSR-15.
- C. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
  1. Pressure Classes of 3-Inch wg (750 Pa) or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.
- D. Rectangular Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design with linkage concealed in frame and suitable for horizontal or vertical applications.
  1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum 16 gauge thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
    - a. Roll-Formed Steel Blades: Galvanized sheet steel, 16 gauge thick for velocities up to 1,500 fpm, and 14 gauge thick for velocities up to 3,000 fpm.
    - b. Blade Axles: Minimum 1/2-inch diameter, plated steel, hex shaped, mechanically attached to blade.
    - c. Bearings: Molded synthetic sleeve, turning in extruded hole in frame.
    - d. Tie Bars and Brackets: Galvanized steel.
    - e. Mill galvanized.
- E. Round Volume Dampers: Single-blade suitable for horizontal or vertical applications.
  1. Steel Frames: Galvanized, roll formed, minimum of 20 gauge thick with beads at each end.
  2. Blades: Minimum 14 gauge thick, galvanized sheet steel, round, single-piece.
  3. Blade Axles: Minimum 1/2-inch square, plated steel, mechanically attached to blade.

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4. Bearings: Molded synthetic sleeve, turning in hole in frame.
  5. Finish: Mill galvanized.
  6. Capacity:
    - a. Closed Position: Maximum pressure of 4-inches wg.
    - b. Open Position: Maximum air velocity of 3,000-feet per minute.
  7. Leakage: Maximum 20 cfm at 4-inches wg.
  8. Pressure Drop: Maximum 0.02-inch wg at 1,500-feet per minute through 20-inch diameter dampers.
- F. Jackshaft: 1-inch diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.
  2. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include 2-inch elevated platform for insulated duct mounting.

#### **2.04 CONCEALED DAMPER HARDWARE**

- A. Manufacturers:
1. Young Regulator Company
- B. Concealed Damper Hardware: For dampers above non-removable ceilings (gyp, plaster, decorative, etc.) where access panels have not been shown on Architectural drawings or in locations where dampers are more than 2-feet above the ceiling, provide:
1. Concealed Damper Regulator: Young Regulator Company Model 315 or approved equivalent.
  2. Cable System: Young Regulator Company or approved equivalent.
  3. Controller: Young Regulator Company 270-275 or approved equivalent.
  4. Control wrenches, wire stops, casing nuts, and stainless steel wire.
  5. Paint cover plate to match ceiling color or as directed by Architect.

#### **2.05 ACCESS DOORS**

- A. Manufacturers:
1. Ductmate
  2. Cesco
  3. Ruskin
  4. Nailor
  5. Outdoor Installation: Karp MX insulated exterior access door.
- B. Duct Pressure Class 2-inch WC and Greater: Sandwich-type design with threaded locking bolt assembly. Closed cell neoprene gasket permanently bonded to inside panel. Zinc-coated steel wing nuts or polypropylene molded knobs with threaded metal inserts - zinc coated bolts sealed to inner panel.
- C. Duct Pressure Class 1-1/2-inch WC and Less: Galvanized steel assembly incorporating frame, door, hinges, and latch(es). Frame tabbed for attachment to duct panel. Double wall door panel with 1-inch insulation. Open cell neoprene gasket attached to frame. Cam latches for tight closure.
- D. Plenum Doors: Extruded aluminum frames with extruded santoprene seals. Double-wall 20 gauge galvanized steel door panel with fiberglass insulation.
- E. Size: Maximum size available to fit rectangular duct panel dimension or round duct diameter. Plenum doors minimum 2-feet wide by 4-feet high.
- F. For outdoor installation, only provide waterproof access doors installed vertically.

#### **2.06 DUCT TEST HOLES**

- A. Manufacturers:

1. Ventlok
- B. Temporary Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct insulation thickness.
- C. Permanent Test Holes (where shown on Drawings): Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

## **2.07 COMBINATION FIRE AND SMOKE DAMPERS**

- A. Manufacturers:
  1. Ruskin
  2. Greenheck
  3. Nailor
  4. Pottorff
  5. Cesco
- B. Basis-of-Design:
  1. Ruskin Model FSD25R, Leakage Class 1, 1-1/2 hour rated, for round ductwork up to 24-inch diameter.
  2. Ruskin Model FSD60, Leakage Class I, 1-1/2 hour rated, for rectangular ducts or round ductwork larger than 24-inch diameter. Provide duct transition between round and rectangular connections. Pressure drop of a 24-inch by 24-inch damper at 1,000 and 2,000 fpm face velocity shall not exceed 0.03 and 0.16 in-wc., respectively.
  3. - C, for use in tunnel corridor applications.
  4. - FA, front access models.
  5. - SS, Stainless Steel Models for use in stainless steel ductwork.
  6. - M, modulating.
  7. - VALR, for use in validated systems.
  8. - XP, for use in explosion proof applications.
  9. - 3, for use in 3-hour rated assemblies.
- C. Ratings:
  1. Fire Resistance: UL 555 classified and provide combination fire and smoke dampers with UL label for fire rating as appropriate for construction rating and in conformance with NFPA 90A.
  2. Smoke Rating: Leakage Class Smoke Damper in accordance with UL555S. Leakage class at 4-inch wg
  3. Elevated Temperature Rating: 250 degrees F.
  4. Air Flow Rating: 3,000 feet per minute.
  5. Differential Pressure Rating: 4-inch wg.
- D. Construction:
  1. Frame: 16 gauge roll formed, galvanized steel hat-shaped channel, reinforced at corners. Structurally equivalent to 13 gauge U-channel type frame.
  2. Blades (Leakage Class I):
    - a. Style: True airfoil-shaped, single piece, double skin.
    - b. Action: Opposed.
    - c. Material: Minimum 14 gauge equivalent thickness, galvanized steel.
    - d. Width: Maximum 6-inches.
  3. Bearings: Self-lubricating stainless steel sleeve type, turning in extruded hole in frame.
  4. Seals:
    - a. Blade: Inflatable silicone fiberglass material to maintain smoke leakage rating to a minimum of 450 degrees F and galvanized steel for flame seal to 1,900 degrees F. Mechanically attached to blade edge (glue-on or grip type seals are not acceptable).
    - b. Jamb: Stainless steel, flexible metal compression type.

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5. Linkage: Concealed in frame.
  6. Axles: Minimum 1/2-inch diameter plated steel, hex-shaped, mechanically attached to blade.
  7. Mounting: Vertical or Horizontal, based on application.
  8. Temperature Release Device: Heat actuated, Quick Detect.
    - a. Close (in a controlled manner) and lock damper during test, smoke detection, power failure, or fire conditions through actuator closure spring. Actuator, at no time, to disengage from damper blades.
    - b. Allow damper to be automatically and remotely reset after test or power failure conditions. After exposure to high temperature or fire, inspect damper before reset to ensure proper operation.
    - c. Controlled closing and locking of damper in 7 to 15 seconds to allow duct pressure to equalize. Instantaneous closure is not acceptable.
  9. Release Temperature: 165 degrees F or 212 degrees F.
  10. Actuator: Electric, two-position, fail close.
  11. Finish: Mill galvanized for installation in galvanized sheet metal and Type 304 stainless steel for installation in stainless steel ductwork.
  12. Firestat:
    - a. UL classified dual temperature device allows the damper to be re-opened after initial closure from high heat.
    - b. Electrically and mechanically locks damper in closed position when duct temperatures exceed 165 degrees F.
    - c. Allow damper to remain operable through a high limit temperature sensor for smoke management purposes while temperature is below 250 degrees F.
    - d. Replaces EFL or PFL Ruskin Controlled Closure heat actuated temperature release devices on standard dampers.
    - e. Blade position indicator switches: Two position indicator switches linked directly to damper blade in order to allow remote indication of damper blade position. Provide separate switches for indication of closed and open position.
    - f. Ruskin TS150 or equivalent.
  13. Indicator or Auxiliary Switch Packages: Not required.
- E. Factory mounting angles.
- F. Factory Sleeve:
  1. Minimum 20 gauge thickness.
    - a. Silicone caulk factory applied to sleeve at damper frame to comply with leakage rating requirements.
    - b. Factory breakaway connections.
    - c. Factory Tests: Factory cycle damper and actuator assembly to assure proper operation.
- G. Damper Control Panel:
  1. Provide damper control panel for maintenance and testing of dampers by a toggle switch or a removable key-type switch, as selected by the Owner. Provide indicator lights to show position of damper. Unit may operate at 120 volt ac or 24 volt dc. Connect to nearest 120-volt power supply provided by Division 26 and provide transformers, as required. Ruskin MCP1 and MCP2 series, or equivalent.

## 2.08 CONTROL DAMPERS

- A. Manufacturers:
1. Ruskin
  2. Greenheck
  3. Cesco
  4. Air Balance

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5. Nailor
- B. Basis-of-Design:
  1. Ruskin Model CDR25, low leakage, for use in low pressure round ductwork up to 24-inch diameter.
  2. Ruskin Model CDO25, low leakage, for use in low pressure oval ductwork.
  3. Ruskin Model CD60, ultra low leakage, for rectangular ducts or round ductwork larger than 24-inch diameter. Provide duct transition between round and rectangular connections.
- C. Fabrication:
  1. Frame: 16 gauge roll formed, galvanized steel hat-shaped channel, reinforced at corners. Structurally equivalent to 13 gauge U-channel.
  2. Blades (Low Leakage Dampers):
    - a. Style: Single skin with 3 longitudinal grooves.
    - b. Action: Opposed blade for modulating applications, parallel blade for two position application.
    - c. Orientation: Horizontal or vertical with thrust washers.
    - d. Material: Minimum 16 gauge equivalent thickness, galvanized steel.
    - e. Width: Nominal 6-inches.
  3. Blades (Ultra Low Leakage Dampers):
    - a. Style: Airfoil-shaped, single-piece.
    - b. Action: Opposed blade for modulating applications, parallel blade for two position applications.
    - c. Orientation: Horizontal or vertical with thrust washers.
    - d. Material: Minimum 14 gauge equivalent thickness, galvanized steel.
    - e. Width: Nominal 6-inches.
  4. Bearings: Molded synthetic sleeve, turning in extruded hole in frame.
  5. Seals:
    - a. Blade: Inflatable PVC coated fiberglass material and galvanized steel. Mechanically attached to blade edge.
    - b. Jamb: Flexible metal compression type.
  6. Linkage: Concealed in frame.
  7. Axles: Minimum 1/2-inch diameter plated steel, hex-shaped, mechanically attached to blade.
  8. Mounting: Vertical or horizontal.
  9. Finish: Mill galvanized for installation in galvanized sheet metal and Type 304 stainless steel for installation in stainless steel ductwork.
- D. Performance Data (Low Leakage Dampers):
  1. Capacity: Demonstrate capacity of damper to withstand HVAC system operating conditions.
    - a. Closed Position: Maximum pressure of 5-inches wg at a 12-inch blade length.
    - b. Open Position: Maximum air velocity of 2,000-feet per minute.
  2. Leakage: Maximum 3.7 cubic-feet per minute per square foot at 1-inch wg for sizes 36-inches wide and above.
  3. Pressure Drop: Maximum 0.07-inch wg at 1,500-feet per minute across 24-inch by 24-inch damper.
- E. Performance Data (Ultra Low Leakage Dampers):
  1. Leakage: Damper to have a maximum leakage of 3 cfm per square foot at 1-inch wg and be AMCA licensed as Class 1A.
  2. Differential Pressure:
    - a. Damper to have a maximum differential pressure rating of 13-inch wg for a 12-inch blade.
  3. Velocity: Damper to have a maximum velocity rating of 6,000-feet per minute.

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4. Temperature: Damper rated for -72 degrees F to 275 degrees F.
  5. Pressure Drop: Maximum 0.1-inch wg at 2,000-feet per minute across 24-inch by 24-inch damper.
- F. Actuator: Provide actuator. See Specification Section 23 09 00, Instrumentation and Control for HVAC.
- G. Factory flange frame
- H. Factory Sleeve: Minimum 20 gauge thickness.
- I. Duct Transition Connection: Per Drawings.
- J. Factory Tests: Factory cycle damper assembly to assure proper operation.

## **2.09 TURNING VANES**

- A. Manufacturers:
1. Aerodyne
  2. Ductmate Industries
  3. Duro Dyno Corp.
  4. Metalaire Inc.
- B. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners to automatically align vanes.
- C. Manufactured Turning Vanes: For medium pressure ductwork, ductwork upstream of terminal units, and in ductwork with equal inlet width and height dimensions and outlet width and height dimension, provide double thickness airfoil turning vanes. Low pressure ductwork and ductwork downstream of terminal units use either single thickness or double thickness turning vanes. For mitered rectangular elbows with changes in size from inlet to outlet, only use single thickness turning vanes. Use 2-inch radius vanes spaced on centers of 1.5-inches for single thickness. Use 2-inch radius vanes spaced on centers of 2.125-inches for double thickness.
- D. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

## **2.10 FLEXIBLE CONNECTORS**

- A. Manufacturers:
1. Duro Dyne Corp.
  2. Ventfabrics Inc.
  3. Ductmate Industries
  4. Hardcast
- B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- C. Metal-Edged Connectors: Factory fabricated with a fabric strip 4-inches wide attached to two strips of 2-3/4-inch wide, 0.028-inch thick, galvanized sheet steel or 0.032-inch thick aluminum sheets. Select metal compatible with ducts.
- D. Provide a spring and bracket assembly to reinforce the fabric with sufficient tension to prevent connector collapse under negative or positive pressure. Number and positioning of spring-link fixture to be determined by the manufacturer to maintain straight axis and without kinks between two sections of duct, or between duct and the moving element. Hardcast Spring-Link SL-200, or equal.
- E. Indoor System, Flexible Connector Fabric (FC-I): Glass fabric double coated with neoprene.
1. Minimum Weight: 30 ounces per square yard.
  2. Tensile Strength: 395 pounds of force per inch in the warp and 255 pounds of force per inch in the filling.
  3. Service Temperature: -40 degrees F to 200 degrees F.



## **PART 3 - EXECUTION**

### **3.01 DUCT ACCESSORIES GENERAL INSTALLATION**

- A. Inspect areas to receive air duct accessories. Notify Engineer of conditions that would adversely affect the installation of the dampers. Do not proceed until conditions are corrected.
- B. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts.
- C. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- D. Do not compress or stretch damper frames into duct or opening.
- E. Handle dampers using sleeve or frame. Do not lift dampers using blades, actuators, or jack shafts.
- F. Adjust duct accessories for proper settings.

### **3.02 SHEET METAL MATERIALS INSTALLATION**

- A. Install bracing for multiple sections to support assembly weights and hold against system pressure. Install bracing as needed.

### **3.03 BACKDRAFT DAMPERS INSTALLATION**

- A. Install backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated. Provide at outside air intakes where motorized dampers are not shown on drawings.

### **3.04 DAMPERS INSTALLATION**

- A. Where installing volume dampers in ducts with liner, avoid damage to and erosion of duct liner.
- B. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts for air balancing. Install at a minimum of two duct widths from each branch takeoff. Provide balancing dampers for all air inlets and outlets.
- C. Install dampers square and free from racking with blade running horizontally.

### **3.05 CONCEALED DAMPER HARDWARE INSTALLATION**

- A. Coordinate location in Reflected Ceiling Plan and color of concealed damper hardware with Architect prior to installation.

### **3.06 ACCESS DOORS INSTALLATION**

- A. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:
  - 1. On both sides of duct coils.
  - 2. Downstream from volume dampers, turning vanes and equipment.
  - 3. Adjacent to fire or smoke dampers, providing access to reset or reinstall fusible links.
  - 4. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot (15-m) spacing.
  - 5. Install the following sizes for duct-mounting, rectangular access doors:
    - a. One-Hand or Inspection Access: 8-inches by 5-inches.
    - b. Two-Hand Access: 12-inches by 6-inches.
    - c. Head and Hand Access: 18-inches by 10-inches.
    - d. Head and Shoulders Access: 21-inches by 14-inches.
    - e. Body Access: 25-inches by 14-inches.
    - f. Body Plus Ladder Access: 25-inches by 17-inches.
  - 6. Install the following sizes for duct-mounting, round access doors:
    - a. One-Hand or Inspection Access: 8-inches in diameter.
    - b. Two-Hand Access: 10-inches in diameter.

- c. Head and Hand Access: 12-inches in diameter.
  - d. Head and Shoulders Access: 18-inches in diameter.
  - e. Body Access: 24-inches in diameter.
7. Label access doors.

### **3.07 DUCT TEST HOLES INSTALLATION**

- A. Provide test holes at fan inlets and outlets where indicated and where required for air testing and balancing.

### **3.08 COMBINATION FIRE AND SMOKE DAMPERS INSTALLATION**

- A. Verify that electric power is available and of correct characteristics.
- B. Coordinate combination fire and smoke dampers with fire alarm system.
- C. Install combination fire and smoke dampers, with fusible links, and in accordance with manufacturer's UL-approved written instructions.
- D. Adjust fire and smoke dampers for proper action.

### **3.09 CONTROL DAMPERS INSTALLATION**

- A. Handle dampers using sleeve or frame. Do not lift dampers using blades, actuators or jack shafts.
- B. Install control dampers in accordance with manufacturer's written instructions.

### **3.10 TURNING VANES INSTALLATION**

- A. Vanes must be installed, eliminating every other vane is not allowed.
- B. Single thickness vanes cannot be over 36-inches long without intermediate vane runner.
- C. Install per SMACNA and fasten/support to prevent vibration, noise, and to maintain proper alignment at design velocity.

### **3.11 FLEXIBLE CONNECTORS INSTALLATION**

- A. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators. Provide sheet metal weather cover over flexible connections located outdoors. Attach sheet metal to either equipment side or ductwork side, but not both.
- B. Per NFPA, do not use flexible connectors on grease exhaust fans.
- C. Securely attach spring-lock brackets to the metal strips of the connector collar using No. 8 sheet metal screws.
- D. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- E. Adjust the following types in the following locations:
  - 1. FC-I: Indoors.

**END OF SECTION**

**SECTION 233400  
HVAC FANS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Centrifugal Fans
  - 2. Roof Exhaust Fans
  - 3. Ceiling Exhaust Fans
  - 4. In-Line Centrifugal Fans

**1.02 RELATED SECTIONS**

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Certified fan performance curves with system operating conditions indicated.
  - 2. Certified fan sound-power ratings.
  - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
  - 4. Material gauges and finishes, including color charts.
  - 5. Dampers, including housings, linkages, and operators.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Motors: Premium efficiency per Section 23 05 13, Common Motor Requirements for HVAC Equipment. Electrically Commutated Motors (ECM) where scheduled on Drawings.
  - 2. Sound power levels as scheduled on Drawings. If not scheduled, within 5 percent of Basis of Design at design flow.
  - 3. Project Altitude: Base air ratings on sea-level conditions for project sites below 2,000 feet in elevation. Base air ratings on actual site elevations for project sites above 2,000 feet in elevation.
  - 4. Operating Limits: Classify according to AMCA 99.
  - 5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
  - 6. AMCA Compliance: Products are to comply with performance requirements and are to be licensed to use the AMCA-Certified Ratings Seal.
  - 7. NEMA Compliance: Motors and electrical accessories are to comply with NEMA standards.
  - 8. UL Standard: HVAC Fans are to comply with UL 705. Fans used in grease exhaust applications are to be UL 762 listed for grease exhaust.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

### **1.08 COORDINATION**

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

### **1.09 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Belts: One set for each belt-driven unit.

## **PART 2 - PRODUCTS**

### **2.01 CENTRIFUGAL FANS**

- A. Manufacturers:
  - 1. Greenheck
  - 2. Cook
  - 3. Twin City
- B. Description: Centrifugal or utility type centrifugal fans, as indicated, standard factory finish, AMCA rated, single width, single inlet, double width, double inlet, forward curved, backward inclined, or airfoil blades as scheduled.
- C. Wheel and Inlet:
  - 1. Backward Inclined: Steel or aluminum construction with smooth curved inlet flange, heavy back plate, backwardly curved blades welded or riveted to flange and back plate; cast iron or cast steel hub riveted to back plate and keyed to shaft with set screws.
  - 2. Airfoil Wheel: Steel construction with smooth curved inlet flange, heavy back plate die formed hollow airfoil shaped blades continuously welded at tip flange, and back plate; cast iron or cast steel hub riveted to back plate and keyed to shaft with set screws.
  - 3. Statically and dynamically balance wheel within its own bearings with maximum balance quality grade at bearings of G16 (0.20 in/sec peak velocity, filter-in as measured at fan RPM) for 5 hp and below and G6.3 (0.15 in/sec peak velocity, filter-in as measured at fan RPM) for 7.5 hp and above per ANSI S2.19. AMCA 210 rated.
- D. Housing:
  - 1. Heavy gauge steel, spot welded for AMCA 99 Class I and II fans, and continuously welded for Class III, adequately braced, designed to minimize turbulence with spun inlet bell and shaped cut.
  - 2. Finish: Factory finish to manufacturer's standard with Hi-Pro polyester finish exceeding 1,000 hours of salt spray under ASTM B117 test method. For fans handling air downstream of humidifiers, provide two additional coats of paint or fabricate of galvanized steel. Prime coating of aluminum parts is not allowed.
  - 3. Removable angles and bolts for attaching flexible connections and discharge dampers on fan outlet.
  - 4. Housing Discharge Arrangement: Adjustable to eight standard positions.
- E. Bearings and Drives:
  - 1. Bearings: Heavy duty pillow block type, self-greasing ball bearings, with ABMA 9 L-10 life at 100,000 hours.

2. Shafts: Hot rolled steel, ground and polished, with keyway, protectively coated with lubricating oil, and shaft guard. Provide anti-corrosive coating.
  3. Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves for motors 5 hp and under, selected so required rpm is obtained with sheaves set at mid-position fixed sheave for 7.5 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of motor.
  4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
  5. Belt Guard: Fabricate to SMACNA Duct Construction Standards - Metal and Flexible; 0.106-inch thick, 3/4-inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
- F. Motor: Integrally mounted, 1800 RPM maximum, with pre-lubricated sealed ball bearings. ODP for motors located indoors and TEFC for motors exposed to moisture.
- G. Accessories:
1. Inlet/Outlet Screens: Galvanized steel welded grid, removable, at unit outlet for outdoor installation, and unit inlet for unducted conditions.
  2. Access Doors: Shaped to conform to scroll, with quick opening latch type handles and gaskets.
  3. Scroll Drain: 1/2-inch steel pipe coupling welded to low point of fan scroll for outdoor installation.
  4. AMCA 99 Type B spark proof construction where scheduled.
  5. Protective coating on fan wheel and interior of fan housing where scheduled. Apply coating before balancing fans and repair any breaks in coating which occur during balancing. One 6-mil coat of white plastic #7122 and one 6-mil coat of black plastic #7122.
  6. Vibration isolation as scheduled and specified. Reference Section 23 05 48, Vibration and Seismic Controls for HVAC Piping and Equipment.

## 2.02 ROOF EXHAUST FANS

- A. Manufacturers:
1. Greenheck
  2. Cook
  3. Twin City
- B. Description: Belt-driven or direct-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- C. Wheel:
1. Single width, single inlet, backward inclined/airfoil blades.
  2. Aluminum hub and wheel with steel inlet bell.
  3. Statically and dynamically balanced with its own bearings.
- D. Housing to match scheduled Basis of Design:
1. Low silhouette type with arched heavy gauge galvanized hood.
- E. Bearings and Drives:
1. Bearings: Heavy duty pillow block type, self greasing ball bearings with ABMA 9 L-10 life at 100,000 hours.
  2. Shafts: Hot rolled steel, ground and polished, with keyway, protectively coated with lubricating oil.
- F. Pulleys: Cast-iron, adjustable-pitch motor pulley.
- G. Fan and motor isolated from exhaust airstream.
- H. Curb: Prefabricated insulated roof curb, galvanized steel, mitered and welded corners; 1-1/2-inch thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer, hinged with

- curb seal. Provide curb for flat, pitched or ridged roof as indicated.
1. Security grates in curb, 1/2-inch powder coated steel bars, 6 by 6-inch grid. Provide where scheduled.
  2. Kitchen grease exhaust meeting NFPA-96 requirements with vented slots. Greenheck VPFV or equal.
  3. Sound curb: Curb with sound-absorbing insulation matrix. Provide where scheduled.
- I. Motor: Integrally mounted, 1800 RPM maximum, with pre-lubricated sealed ball bearings. ODP for motors located indoors and TEFC for motors exposed to moisture.
1. Inverter duty motor for use with variable frequency drive where indicated on Fan Schedule on Drawings.
  2. Electrically Commutated Motor (ECM) where indicated on Fan Schedule on Drawings.
- J. Accessories:
1. Inlet/Outlet Screens: Galvanized steel welded grid, removable.
  2. Backdraft Damper: Parallel blade heavy duty steel or aluminum, where scheduled, damper assembly with blades constructed of two plates formed around and welded to shaft, channel frame, sealed ball bearings, with blades linked out of air stream to single control lever. Motorized where indicated and gravity actuated with counterweight, where motorized is not indicated.
  3. Protective coating on fan wheel and interior of fan housing where scheduled. Apply coating before balancing fans and repair any breaks in coating which occur during balancing. One 6-mil coat of white plastic #7122 and one 6-mil coat of black plastic #7122.
  4. Variable-Speed Controller: Where scheduled on Drawings, provide solid-state control to reduce speed from 100 percent to less than 50 percent.
  5. Disconnect Switch: Where not shown on Division 26, Electrical Drawings, provide nonfusible type, with thermal-overload protection mounted inside fan housing factory wired through an internal aluminum conduit.
  6. Vibration Isolation: Wheel and motor mounted on integral double deflection neoprene isolators.

### 2.03 CEILING EXHAUST FANS

- A. Manufacturers:
1. Greenheck
  2. Cook
  3. Broan
  4. Twin City
  5. Panasonic
- B. Description: Centrifugal fan, direct drive, cabinet and exhaust grille. AMCA rated. Sound level as scheduled. Fan shrouds, motor, and fan wheel are to be removable for service.
- C. Wheel: Double width, double inlet, forward curved blades:
- D. Housing: Acoustically insulated steel casing, factory standard finish, bottom access through grille, ducted outlet, egg crate inlet grille. Provide stainless steel grille where scheduled.
- E. Drives: Direct drive.
- F. Back draft damper.
- G. Accessories:
1. Disconnect plug.
  2. Flat roof cap.
  3. Hooded wall cap.
  4. Pitched roof cap.
  5. Elbow discharge with grille.
  6. Louvered wall discharge with bird screen.

- H. Motor: Integrally mounted with pre-lubricated sealed ball bearings. Engineered and rated to run continuously.
  - 1. Variable-Speed Controller: Where scheduled on Drawings, provide solid-state control to reduce speed from 100 percent to less than 50 percent.
  - 2. Disconnect Switch: Where not shown on Division 26, Electrical Drawings, provide nonfusible type, with thermal-overload protection mounted inside fan housing factory wired through an internal aluminum conduit.
  - 3. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
  - 4. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
  - 5. Motion Sensor: Motion detector with adjustable shutoff timer.
  - 6. Electrically Commutated Motor (ECM) where indicated on Fan Schedule on Drawings.
- I. Filter: Washable aluminum to fit between fan and grille.
- J. Isolation: Rubber-in-shear vibration isolators.

#### **2.04 IN-LINE CENTRIFUGAL FANS**

- A. Manufacturers:
  - 1. Greenheck
  - 2. Cook
  - 3. Twin City
- B. Description: In-line centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.
- C. Wheel: Cast aluminum backward inclined with inlet cone statically and dynamically balanced within its own bearings.
- D. Housing:
  - 1. Heavy gauge steel or aluminum housing, suitable for Fan Class, factory standard finish.
  - 2. Removable panels for access to all interior components.
  - 3. Horizontal or vertical configuration, as indicated.
  - 4. Inlet and discharge duct collars.
  - 5. 1-inch thick, 1.5 pounds per cubic foot density fiberglass liner.
  - 6. Aluminum straightening vanes.
  - 7. Support bracket adaptable to floor, sidewall, or ceiling mounting.
- E. Bearings and Drives:
  - 1. Bearings: Heavy duty pillow block type, self greasing ball bearings with ABMA 9 life at 50,000 hours.
  - 2. Shafts: Hot rolled steel, ground and polished, with keyway, protectively coated with lubricating oil.
  - 3. Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves for motors 5 hp and under, selected so required rpm is obtained with sheaves set at mid-position. Fixed sheave for 7.5 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of motor. Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
    - a. Inverter duty motor for use with variable frequency drive where indicated on Fan Schedule on Drawings.
  - 4. Drive: Direct drive matched to fan loads with speed controller. Motor encased in housing outside of airstream, factory wired to disconnect switch located on outside of fan housing.
    - a. Electrically Commutated Motor (ECM) where indicated on Fan Schedule on Drawings.
- F. Accessories:
  - 1. Belt guard.

2. Variable-Speed Controller: Provide solid-state control to reduce speed from 100 percent to less than 50 percent for motors 1/2 HP or smaller.
  3. Discharge Dampers: Parallel blade for mixing or open/close applications and opposed blade for modulating . Heavy duty steel or aluminum, where scheduled. Damper assembly with blades constructed of two plates formed around and welded to shaft, channel frame, sealed ball bearings, with blades linked out of air stream to single control lever. Motorized where indicated and gravity actuated with counterweight, where motorized is not indicated.
  4. Flat roof cap.
  5. Hooded wall cap.
  6. Pitched roof cap.
  7. Elbow discharge with grille.
  8. Louvered wall discharge with bird screen.
- G. Inlet/Outlet Screens: Galvanized steel welded grid, removable.
- H. Vibration Isolation: Wheel and motor mounted on integral double deflection neoprene isolators.
- I. Vibration isolation as scheduled and specified. Reference Section 23 05 48, Vibration and Seismic Controls for HVAC Piping and Equipment.
1. Motor: Integrally mounted, 1800 RPM maximum, with pre-lubricated sealed ball bearings. ODP for motors located indoors and TEFC for motors exposed to moisture.

### **PART 3 - EXECUTION**

#### **3.01 GENERAL INSTALLATION REQUIREMENTS**

- A. Install in accordance with manufacturer's instructions.
- B. Install power ventilators level and plumb.
- C. Fans used for exhaust of kitchen grease hoods are to be UL 762 listed for grease exhaust. Provide fans with grease terminator. Pipe from grease terminator to Code approved location.
- D. Fans used for exhaust of moist air are to be constructed of aluminum construction and be warranted for their application in moist conditions.
- E. Fans used in welding, chemical, and/or fume exhaust applications are to be of spark-proof construction and are to be protected with coatings as required to protect parts in the air stream from the chemicals and materials the fan will be exposed to.
- F. Install floor-mounting units on concrete bases.
- G. Units using vibration isolation devices are scheduled on Drawings.
- H. Support suspended units from structure threaded steel rods and vibration isolation device scheduled on Drawings.
- I. In seismic zones, restrain support units.
- J. Install units with clearances for service and maintenance.
- K. Provide fixed sheaves required for final air balance.
- L. Provide safety screen where inlet or outlet is exposed.
- M. Pipe scroll drains to nearest floor drain.
- N. Provide backdraft dampers on discharge of exhaust fans and as indicated on Drawings.
- O. Duct installation and connection requirements are specified in other Division 23, HVAC Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors per Section 23 33 00, Air Duct Accessories.
- P. Install ducts adjacent to power ventilators to allow service and maintenance.
- Q. Ground equipment.



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- R. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- S. Equipment Startup Checks:
  - 1. Verify that shipping, blocking, and bracing are removed.
  - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
  - 3. Verify that cleaning and adjusting are complete.
  - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
  - 5. Verify lubrication from bearings and other moving parts.
  - 6. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
  - 7. Disable automatic temperature-control operators.
- T. Starting Procedures:
  - 1. Energize motor and adjust fan to indicated rpm.
  - 2. Measure and record voltage and amperage.
- U. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
- V. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- W. Shut unit down and reconnect automatic temperature-control operators.
- X. Replace fan and motor pulleys as required to achieve design airflow.
- Y. Provide totally enclosed fan cooled motors when motor is located outdoors, whether under a cover or not, or exposed to moisture. Provide protective covering for electronically commutated motors located in outdoor or wet/wash-down locations.
- Z. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.
- AA. Adjust damper linkages for proper damper operation.
- BB. Adjust belt tension.
- CC. Lubricate bearings.
- DD. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.
- EE. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.
- FF. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC fans. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.

### **3.02 ROOF EXHAUST FANS**

- A. Secure roof exhaust fans to roof curbs with cadmium-plated hardware.

### **3.03 CEILING EXHAUST FANS**

- A. Suspend units from structure; use steel wire or metal straps.

**END OF SECTION**

**SECTION 234000  
HVAC AIR CLEANING DEVICES**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Disposable Panel Filters
  - 2. Medium Efficiency Pleated Filters
  - 3. High Efficiency Pleated Filters
  - 4. Filter Gauges

**1.02 RELATED SECTIONS**

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
  - 1. Division 01, General Requirements, Temporary Facilities and Controls: Filters for temporary heating and ventilating.
  - 2. Division 26, Electrical, Equipment Wiring: Electrical characteristics and wiring connections.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. ANSI/AHRI 850 I-P - Performance Rating of Commercial and Industrial Air Filter Equipment.
  - 2. ASHRAE Std 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
  - 3. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
  - 4. MIL-STD-282 - Filter Units, Protective Clothing, Gas-Mask Components, and Related Products: Performance-Test Methods; Military Specifications and Standards.
  - 5. UL 586 - High Efficiency, Particulate, Air Filter Units; Underwriters Laboratories Inc.
  - 6. UL 867 - Electrostatic Air Cleaners; Underwriters Laboratories Inc.
  - 7. UL 900 - Standard for Air Filter Units; Underwriters Laboratories Inc.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Product Data: Provide data on filter media, filter performance data, filter assembly and filter frames, dimensions, motor locations and electrical characteristics and connection requirements.
  - 2. Shop Drawings: Indicate filter assembly and filter frames, dimensions, motor locations, and electrical characteristics and connection requirements.
  - 3. Manufacturer's Installation Instructions: Indicate assembly and change-out procedures.
  - 4. Operation and Maintenance Data: Include instructions for operation, changing, and periodic cleaning.
  - 5. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    - a. See Division 01, General Requirements for additional provisions.
    - b. Extra Filters: One set of each type and size.

### **1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

### **1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

### **1.07 PERFORMANCE REQUIREMENTS**

- A. Conform to ANSI/AHRI 850 I-P - Performance Rating of Commercial and Industrial Air Filter Equipment, Section 7.4.
  - 1. Dust Spot Efficiency: Plus or minus 5 percent.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Filters:
  - 1. American Filtration Inc.
  - 2. AAF International/American Air Filter
  - 3. Camfil Farr Company
  - 4. Eco-Air Products
  - 5. Filtration Group
  - 6. Flanders Corporation
- B. Filter Gauges:
  - 1. Dwyer Instruments
  - 2. H.O. Treric Co.
  - 3. Weiss Instruments

### **2.02 DISPOSABLE PANEL FILTERS**

- A. Media: UL 900 Class 2, fiber blanket, factory sprayed with flameproof, non-drip, non-volatile adhesive.
  - 1. Nominal Size: 12 x 24-inches.
  - 2. Thickness: 2-inch.
- B. Performance Rating:
  - 1. Face Velocity: 500 FPM.
  - 2. Face Velocity: 350 FPM (2.54 m/sec).
  - 3. Initial Resistance: 0.15-inch WG.
  - 4. Initial Resistance: 0.23-inch WG (37 Pa).
  - 5. Recommended Final Resistance: 0.50-inches WG.
  - 6. MERV Rating: 8.
- C. Holding Frames: 20 gauge minimum galvanized steel frame with expanded metal grid on outlet side and steel rod grid on inlet side, hinged with pull and retaining handles.

### **2.03 MEDIUM EFFICIENCY PLEATED FILTERS**

- A. Media: Blend of cotton and polyester fiber, pleated, support grid, enclosing frame, UL 900.
  - 1. Thickness 4-inch.
- B. Performance Rating per ASHRAE Standard 52.2:
  - 1. MERV 11.
  - 2. Dust Spot Efficiency: 25 to 30 percent.
  - 3. Face Velocity: 500 FPM.

4. Initial Resistance: 0.30-inch WG.
  5. Recommended Final Resistance: 0.90-inches WG.
- C. Frame: Provide galvanized steel frame, including support hardware with air tight seal around frame, upstream servicing.

#### **2.04 HIGH EFFICIENCY PLEATED FILTERS**

- A. Media: Microfine glass fiber laminated to reinforcing backing, pleated, support grid, mechanically and chemically bonded to enclosing frame, UL Class 1.
1. Thickness: 12-inch.
- B. Performance Rating per ASHRAE Standard 52.1 and Standard 52.2:
1. MERV 13.
  2. Dust Spot Efficiency: 80 to 85 percent.
  3. Face Velocity: 500 FPM.
  4. Initial Resistance: 0.50 inch WG.
  5. Recommended Final Resistance: 1.50-inches WG.
- C. Frame: Provide galvanized steel frame, including support hardware with air tight seal around frame, upstream servicing.

#### **2.05 FILTER GAUGES**

- A. Direct Reading Dial: 3-1/2-inch diameter diaphragm actuated dial in metal case, vent valves, black figures on white background, front recalibration adjustment, range based on filter's recommended final resistance, 2 percent of full scale accuracy.
- B. Inclined Manometer: One piece molded plastic with epoxy coated aluminum scale, inclined-vertical indicating tube and built-in spirit level, range 0-3-inch WG, 3 percent of full scale accuracy.
- C. Accessories: Static pressure tips with integral compression fittings, 1/4-inch aluminum tubing, 2-way or 3-way vent valves.

### **PART 3 - EXECUTION**

#### **3.01 GENERAL INSTALLATION REQUIREMENTS**

- A. Install air cleaning devices in accordance with manufacturer's instructions.
- B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.
- C. Furnish and install filter gauge static pressure tips upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum, in accessible position/location. Adjust and level.
- D. Operation During Construction: If air handlers are operated during construction, provide treated 2-inch media construction filter in front of prefilters and replace periodically to prevent dirt carryover. Install clean prefilters prior to air balancing.
- E. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with clean set.
- F. Provide filter gauges on filter banks, installed with separate static pressure tips upstream and downstream of filters.

#### **3.02 SCHEDULES**

- A. Air Filter Schedule
- B. Drawing Code
- C. Location
- D. Type
- E. Number

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- F. Size
- G. Air Flow
- H. Face Velocity
- I. Overall Height
- J. Overall Width
- K. Initial Resistance
- L. Final Resistance

**END OF SECTION**

**SECTION 237400**  
**ROOFTOP PACKAGED AIR CONDITIONING UNITS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included: Materials, installation and testing of roof-mounted, packaged direct expansion air conditioning units in the following configuration:
  - 1. Rooftop Packaged Air Conditioning Units, Constant Volume (up to 20 tons).

**1.02 RELATED SECTIONS**

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
  - 2. AHRI 270 - Sound Performance Rating of Outdoor Unitary Equipment (with Addendum 1).
  - 3. AHRI 340/360 - Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
  - 4. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils (with Addenda 1, 2 & 3).
  - 5. AHRI 1060 I-P - Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation Equipment.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Interior surfaces of units to meet erosion and growth resistance requirements as well as construction requirements for equipment of ASHRAE 62.1, latest edition.
  - 2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
  - 3. Fabricate and label refrigeration system to comply with ASHRAE 15, Safety Code for Mechanical Refrigeration.
  - 4. Energy-Efficiency Ratio: Meet minimum requirements shown on Drawings.
  - 5. Coefficient of Performance: Meet minimum requirements shown on Drawings.
  - 6. Comply with NFPA 54 for gas-fired furnace section. Classified in accordance with ANSI Z 21.47.
  - 7. AHRI Certification: Provide AHRI certified and listed units.
  - 8. AHRI Compliance for Units with Capacities Less Than 135,000 Btuh (39.6 kW): Rate rooftop air-conditioner capacity according to AHRI 210/240, Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
  - 9. AHRI Compliance for Units with Capacities 135,000 Btuh (39.6 kW) and More: Rate rooftop air-conditioner capacity according to AHRI 340/360, Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
  - 10. Sound Power Level Ratings: Comply with AHRI 270, Sound Performance Rating of Outdoor Unitary Equipment (with Addendum 1).

## **1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Provide total 5 years manufacturer's warranty for compressor(s), including parts and labor.
  - 2. Provide 5 year manufacturer warranty on heat exchanger.

## **1.07 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fan Belts: One set for each belt-drive fan.
  - 2. Filters: One set of filters for each unit.

## **PART 2 - PRODUCTS**

### **2.01 ROOFTOP PACKAGE AIR CONDITIONING UNITS, CONSTANT VOLUME (UP TO 20 TONS)**

- A. Manufacturers:
  - 1. Trane Company
  - 2. York/JCI
  - 3. Daikin Applied
  - 4. AAON
  - 5. Valent
  - 6. Lennox International
- B. Description: Factory assembled and tested; designed for outdoor installation; consisting of compressor, indoor and outside refrigerant coils, indoor fan and outside coil fan, refrigeration and temperature controls, gas furnace heat exchanger, filters, dampers and other accessories/devices listed in this specification and the drawings.
- C. Casing: Galvanized steel construction with enamel paint finish, removable panels or access doors with neoprene gaskets for inspection and access to internal parts, minimum 3/4-inch thick thermal insulation, knockouts for electrical and piping connections, exterior condensate drain connection, and lifting lugs. Double wall construction. Finished panel surfaces to withstand a minimum 1000-hour salt spray test in accordance with ASTM B117 standard for salt spray resistance. Unit base to overhang the roof curb for positive water runoff and to seat on the roof curb gasket to provide a positive weather tight seal.
- D. Indoor Fan:
  - 1. Double width, double inlet (DWDI) forward curved, centrifugal, directly driven by multispeed motor.
  - 2. Fan assembly to have adjustable pitched sheaves on the motor. Bushings to be used on sheaves to allow for easy removal of the pulleys from the fan and motor shaft. Fixed bore pulleys fastened to the shaft by setscrews will not be allowed. Drives selected with a 1.2 service factor.
  - 3. Fan assemblies statically and dynamically balanced at the factory, including a final trim balance, prior to shipment. Fan assemblies to employ solid steel fan shafts. Bearings sized to provide a L-50 life of 250,000 hours.
  - 4. Provide fan motors heavy-duty, 1800 rpm, open drip-proof (ODP). Motors efficiencies to meet EPAAct premium efficiencies. Motors mounted on an adjustable base that provides for proper alignment and belt tension adjustment.
  - 5. Fan design to allow for the fan and motor assembly to slide out of the rooftop unit for ease of servicing the equipment.
- E. Outside Coil Fan: Condenser fans to be direct drive, axial type designed for low tip speed and vertical air discharge. Condenser fan rpm to be 1140 rpm maximum. Fan blades constructed of steel and riveted to a steel center hub. Condenser fan motors to be heavy-duty, non reversing

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type with permanently lubricated ball bearing and thermal protection. Motor design to be totally enclosed air over (TEAO).

- F. Refrigerant Coils: Aluminum fin and seamless copper tube in steel casing with equalizing-type vertical distributor. Provide phenolic epoxy corrosion-protection coating to both coils. Coils factory leak tested with high pressure air under water. Provide condenser coils protected from incidental contact to coil fins by a coil guard.
- G. Compressor: Hermetic scroll compressor with integral vibration isolators, internal overcurrent and overtemperature protection, internal pressure relief.
- H. Refrigeration System:
  - 1. Compressor with an automatic-reset control that shuts compressor off after five minutes.
  - 2. Outside coil and fan.
  - 3. Indoor coil and fan.
  - 4. Four-way reversing valve and suction line accumulator.
  - 5. Thermal expansion valve with replaceable thermostatic element and liquid line filter drier.
  - 6. Refrigerant dryer.
  - 7. High-pressure switch.
  - 8. Low-pressure switch.
  - 9. Thermostat for coil freeze-up protection during low-ambient temperature operation or loss of air.
  - 10. Low-ambient switch.
  - 11. Brass service valves installed in discharge and liquid lines.
  - 12. Refrigerant gauge parts.
  - 13. Charge of refrigerant (R-410a or R-407c) and oil.
  - 14. Independent refrigerant circuits where unit has multiple compressors.
- I. Drain Pan: Stainless steel, positively sloped drain pan provided with the cooling coil. Drain pan to extend beyond the leaving side of the coil and underneath the cooling coil connections. Drain pan to have a minimum slope of 1/8-inch per foot to provide positive draining. The slope of the drain pan to be in two directions and comply with ASHRAE Standard 62.1. Drain pan to be connected to a threaded drain connection extending through the unit base.
- J. Filters: Throwaway filters in filter rack. Filters similar to Farr 30/30.
- K. Electric Heat: Helix-wound, nickel-chrome, electric-resistance elements, factory wired for single-point wiring connection; with time delay for element staging, and overcurrent and overheat protective devices.
- L. Outdoor/Return Air Section: A return air plenum to be provided with an outdoor air hood. Hood to allow outdoor air to enter at the back of the return air plenum. Hood to include moisture eliminator filters to drain water away from the entering air stream. Return air plenum to allow return air to enter from the bottom of the unit. Upon unit shut down during unoccupied periods, the outdoor air damper to be power driven closed.
- M. Outside-Air Damper: Linked damper blades, for 0 to 30 percent outside air, with fully modulating, spring return damper motor. Upon unit shut down during unoccupied periods, the outdoor air damper to be power driven closed. Damper blades to be gasketed with side seals and jamb seals to provide an air leakage rate of no more than 4 cfm/square foot of damper area at 1-inch differential pressure per ASHRAE 90.1 Energy Standard. Leakage rate to be tested in accordance with AMCA standard 500.
- N. Economizer: Return- and outside-air dampers with neoprene seals, outside-air filter, and hood. Upon unit shut down during unoccupied periods, the outdoor air damper to be power driven closed. Damper blades to be gasketed with side seals and jamb seals to provide an air leakage rate of no more than 4 cfm/square foot of damper area at 1-inch differential pressure per ASHRAE 90.1 Energy Standard. Leakage rate to be tested in accordance with AMCA standard 500.
  - 1. Damper Motor: Fully modulating spring return with adjustable minimum position.



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2. Control: Electronic-control system uses outside-air temperature to adjust mixing dampers.
  3. Relief Damper: Gravity actuated with bird screen and hood.
- O. Power Connection: Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in circuit breaker.
- P. Electrical: Unit wiring to comply with NEC requirements and with applicable UL standards. Electrical components to be UL recognized where applicable. Wiring and electrical components provided with the unit to be number and color coded and labeled according to the electrical diagram provided for easy identification. The unit to be provided with a factory wired weatherproof control panel. Unit to have a single point power connection for main power connection. A terminal board to be provided for low voltage control wiring. Each compressor and condenser fan motor to be furnished with contactors and thermal overload protection. Supply fan motors to have a factory installed and wired control contactor. Knockouts to be provided in the bottom of the main control panels for field wiring entrance.
- Q. Unit Controls: Solid-state control board and components contain at least the following features:
1. Indoor fan on/off relay.
  2. Default control to ensure proper operation after power interruption.
  3. Service relay output.
  4. Unit diagnostics and diagnostic code storage.
  5. Field-adjustable control parameters.
  6. Defrost control.
  7. Dehumidification control with dehumidistat.
  8. Economizer control.
  9. Electric heat staging.
  10. Gas valve delay between first- and second-stage firing.
  11. Indoor-air quality control with carbon dioxide sensor.
  12. Low-ambient control, allowing operation down to 0 degrees F (minus 18 deg C).
  13. Minimum run time.
  14. Night setback mode.
  15. Return-air temperature limit.
  16. Smoke alarm with smoke detector installed in return air.
  17. Low-refrigerant pressure control.
  18. Digital display of outside temperature, supply-air temperature, return-air temperature, economizer damper position, indoor-air quality, and control parameters.
- R. DDC: Install stand-alone control module providing link between unit controls and DDC system. Control module to be compatible with temperature-control system through BACnet interface.
- S. Thermostat: Programmable, electronic; with heating setback and cooling setup with seven-day programming; and the following:
1. Touch sensitive keyboard.
  2. Automatic switching.
  3. Degree F or degree C readout.
  4. LED indicators.
  5. Hour/day programming.
  6. Manual override capability.
  7. Time and operational mode readout.
  8. Status indicator.
  9. Battery backup.
  10. Subbase with manual system switch (on-heat-auto-cool) and fan switch (auto-on).
  11. Fan-proving switch to lock out unit if fan fails.
  12. Dirty-filter switch.
- T. Accessories:
1. Service Outlets: Two, 115-V, ground-fault, circuit-interrupter type.

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2. Condensate drain trap.
  3. Dirty-filter switch.
- U. Roof Curb:
1. 14 gauge galvanized steel with corrosion-protection coating, gasketing, and factory-installed wood nailer; complying with NRCA standards; minimum height of 14-inches.
  2. Insulate interior of the curb with 2-inches of 1.5 pound neoprene coated fiberglass insulation.
  3. Provide seismic restraints to secure the unit to the curb in accordance with Code.

### **PART 3 - EXECUTION**

#### **3.01 GENERAL INSTALLATION REQUIREMENTS**

- A. Examine areas and conditions under which units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Roof curb to be mounted level on roof in accordance to NRCA manuals and details. Secure to structure per engineered/sealed seismic installation details.
- C. Unit to be secured to curb per seismic installation details.
- D. Provide external vibration isolation or isolation curb to prevent transmission of unit-borne sound and vibration to building structure. Provide flexible connections for electrical power and fuel piping.
- E. Seal openings between curb, roof opening, ducts, electrical conduits, piping, and building interior.
- F. Protect the roof from damage during installation. Secure factory touch-up paint to repair scratches and minor damage to equipment prior to start-up. Comb evaporator and condenser coils to repair any minor fin damage.
- G. Control wiring from roof-mounted equipment must be routed in conduit from above roof to inside building or must be routed through roof curb inside unit. Control wiring must not be exposed to weather.
- H. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- I. Perform the following field quality-control tests and inspections and prepare test reports:
  1. After installing rooftop air conditioners and after electrical circuitry has been energized, test units for compliance with requirements.
  2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
  3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- J. Remove malfunctioning units, replace with new units, and retest as specified above.
- K. Engage a factory-authorized service representative to perform startup service.
- L. Protect or remove energy recovery devices prior to starting the units to ensure damage does not occur to the devices or media. Replace at no cost to Owner if devices/media get damaged or are no longer in "as-new" condition.
- M. Complete installation and startup checks according to manufacturer's written instructions and do the following:
  1. Inspect for visible damage to unit casing.
  2. Inspect for visible damage to furnace combustion chamber.
  3. Inspect for visible damage to compressor, air-cooled outside coil, energy recovery devices, internal coils, and fans.

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4. Inspect internal insulation.
5. Verify that labels are clearly visible.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Verify that filters are installed.
9. Clean outside coil and inspect for construction debris.
10. Clean furnace flue and inspect for construction debris.
11. Connect and purge gas line.
12. Adjust vibration isolators.
13. Inspect operation of barometric dampers.
14. Lubricate bearings on fan.
15. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
16. Adjust fan belts to proper alignment and tension.
17. Start unit according to manufacturer's written instructions.
  - a. Coordinate starting of refrigeration system during winter with manufacturer.
  - b. Complete startup sheets and attach copy with Contractor's startup report.
18. Inspect and record performance of interlocks and protective devices; verify sequences.
19. Operate unit for an initial period as recommended or required by manufacturer.
20. Perform the following operations for both minimum and maximum firing and adjust burner for peak efficiency. Adjust pilot to stable flame.
  - a. Measure gas pressure on manifold.
  - b. Measure combustion-air temperature at inlet to combustion chamber.
  - c. Measure flue-gas temperature at furnace discharge.
  - d. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
  - e. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
21. Calibrate thermostats.
22. Adjust and inspect high-temperature limits.
23. Inspect outside-air dampers for proper stroke and interlock with return-air dampers.
24. Start refrigeration system and measure and record the following:
  - a. Coil leaving-air, dry- and wet-bulb temperatures.
  - b. Coil entering-air, dry- and wet-bulb temperatures.
  - c. Outside-air, dry-bulb temperature.
  - d. Outside-air-coil, discharge-air, dry-bulb temperature.
25. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
26. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
  - a. Supply-air volume.
  - b. Return-air volume.
  - c. Relief-air volume.
  - d. Outside-air intake volume.
27. Simulate maximum cooling demand and inspect the following:
  - a. Compressor refrigerant suction and hot-gas pressures.
  - b. Short circuiting of air through outside coil or from outside coil to outside-air intake.
28. Verify operation of remote panel, including pilot-light operation and failure modes. Inspect the following:
  - a. High-limit heat exchanger.
  - b. Warm-up for morning cycle.
  - c. Freezestat operation.
  - d. Economizer to limited outside-air changeover.

- e. Alarms.
- 29. After startup and performance testing, change filters, vacuum heat exchanger and cooling and outside coils, lubricate bearings, adjust belt tension, and inspect operation of power vents.
- N. Adjust initial temperature, humidity, and CO2 set points.
- O. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- P. Occupancy Adjustments: Within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose, without additional cost.
- Q. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain rooftop air conditioners. Reference Division 01, General Requirements.

**3.02 ROOFTOP PACKAGE AIR CONDITIONING UNITS, CONSTANT VOLUME (UP TO 20 TONS) INSTALLATION**

- A. Verify gas flue clearance from adjacent air intakes and building openings per local code and latest version of ASHRAE 62.1 prior to installation. Provide manufacturer's flue extension(s) if unable to maintain horizontal clearances.
- B. Piping installation requirements are specified in other Division 23, HVAC Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Duct installation requirements are specified in other Division 23, HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
  - 1. Install ducts to termination in roof curb.
  - 2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
  - 3. Terminate return-air duct through roof structure.
  - 4. Fill void between roof and bottom of unit with 3-pound density acoustic batt.
- D. Electrical System Connections: Comply with applicable requirements in Division 26, Electrical Sections for power wiring, switches, and motor controls.
- E. Ground equipment according to Division 26, Electrical.
- F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

**END OF SECTION**

**SECTION 237443  
PACKAGED MAKE-UP AIR UNIT**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Packaged DX
  - 2. Filters
  - 3. Roof Curb
  - 4. Electrical
  - 5. Controls

**1.02 RELATED SECTIONS:**

- A. Contents of Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
  - 1. Section 23 05 13, Common Motor Requirements for HVAC Equipment
  - 2. Section 23 05 93, Testing, Adjusting, and Balancing for HVAC
  - 3. Section 23 09 00, Instrumentation and Control Performance Specifications
  - 4. Division 26, Electrical

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following certifications:
  - 1. ETL Certified per ANSI Z83.4 or ANSI Z83.18 and bear an ETL mark.
  - 2. ANSI/UL 1995, CAN / CSA C22.2 No. 236.05 for coils.
  - 3. AHRI Certified per Standard 410-2001 for DX and water coils.
  - 4. Indirect Gas-Fired Heaters: ETL Certified as a component of the unit.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Product Data: For each type or model include the following:
    - a. Fan performance curves for supply air, with system operating conditions indicated, as tested on an AMCA Certified Chamber.
    - b. Sound performance data for supply air, as tested on an AMCA Certified chamber.
    - c. Motor ratings, electrical characteristics and motor and fan accessories.
    - d. Performance ratings for DX coils.
    - e. Dimensioned drawings for each type of installation, showing isometric and plan views, to include location of attached ductwork and service clearance requirements.
    - f. Gross weight of each unit.
    - g. Installation, Operation and Maintenance Manual for each model.
    - h. Microprocessor DDC Controller specifications to include features and operating protocols. Include complete data on all factory-supplied input devices.
  - 2. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
  - 3. Manufacturer's Instructions: Include installation instructions
  - 4. Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, accessories listed in this specification, and wiring diagrams.

5. Certificates: Certify that coil capacities, pressure drops and selection procedures meet or exceed specified requirements.

### **1.05 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Filters: One set of spare filters for each unit.
  2. One set of fan belts.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Approved Manufacturers:
  1. Greenheck
  2. Reznor
  3. Modine

### **2.02 MANUFACTURED UNITS**

- A. Provide unit with integral heating and cooling fully assembled at the factory and consisting of an insulated metal cabinet, motorized outdoor air intake damper, Packaged DX, and curb assembly, filter assembly for intake air, supply air blower assembly and an electrical control center. All specified components and internal accessories factory installed and tested and prepared for single-point high voltage connection.

### **2.03 CABINET**

- A. Materials: Double wall metal cabinet with fiberglass duct liner insulation, fabricated to permit access to internal components for maintenance. For suspended units provide metal panels covering base panel insulation at underside of unit.
  1. Outside casing: 18 gauge G60 galvanized steel with factory applied polyester urethane paint, 2-3 mils Permator polyurethane paint, 1,000 hours salt spray test per ASTM B117.
  2. Internal assemblies: 24 gauge, G90 galvanized steel except for motor supports which are to be minimum 14 gauge G90 galvanized steel.
- B. Cabinet Insulation: Comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.
  1. Materials: Fiberglass insulation. If insulation other than fiberglass is used, it must also meet the Fire Hazard Classification shown below:
    - a. Thickness: 1-inch.
    - b. Fire Hazard Classification: Maximum flame spread of 25 and smoke developed of 50, when tested in accordance with ASTM C 411.
    - c. Location and application: Insulate floor of each unit with 1-inch thick rigid fiberglass insulation, covered on one surface with integral aluminum foil. Provide full interior coverage of entire cabinet to include walls and roof of unit of semi-rigid type and install between inner and outer shells of all cabinet exterior components.
- C. Access panels: Equip unit with insulated and hinged access panels to provide easy access to all major components. Fabricate access panels from 18 gauge G90 galvanized steel. Removable access panels incorporate a formed drip edge.
- D. Supply Air blower assembly: Blower assembly consists of an electric motor and a belt driven, double width, and double inlet forward curve blower. Mount assembly on heavy gauge galvanized rails, mounted on seismically braced spring isolation devices with not less than 1.5-inch static deflection.
- E. Control panel / connections: Provide unit with an electrical control center where all power supply connections are made. Construct control center to permit single-point high voltage power supply connections.

- F. Packaged DX: Where shown on Drawings, equip unit with a Packaged DX system, including compressor(s), evaporator and condenser coil(s), condensate drain pan, condenser fans and all appurtenant controls.
- G. Motorized Recirculating Air Damper: For units equipped with a return air connection, provide factory installed motorized damper at the return air path designed to permit 100 percent recirculation of relief air. Control damper by external signal from BMS.
- H. Freeze Protection for Water Coil: Provide an adjustable temperature sensing bulb that disables the fan motor.
- I. Motorized dampers at Outdoor Air Intake: Provide factory installed insulated low leakage motorized damper at outdoor air intake.
- J. Sensors: Provide sensors required for proper operation of the unit.
- K. Roof Curb: Provide a roof curb assembly made of 14 gauge galvanized steel to provide perimeter support of the entire unit and have duct adapter(s) for supply air, and where shown on drawings return air. Curb assembly to enclose the underside of the unit and sized to fit into a recess in the bottom of the unit.
- L. Service Receptacle: Furnish 120 VAC GFCI service outlet for installation by Division 23.

#### **2.04 BLOWER**

- A. Blower section construction, supply air: Assemble belt drive motor and blower onto a minimum 14 gauge galvanized steel platform and with helical coil spring vibration isolation devices.
- B. Blower assemblies: Statically and dynamically balance blower assemblies and design for continuous operation at maximum rated fan speed and horsepower.
- C. Centrifugal blower housing: Provide formed and reinforced steel panels to make curved scroll housing with shaped cutoff.
- D. Forward curved blower (fan) wheels: Provide galvanized or aluminum construction with inlet flange and shallow blades curved forward in direction of airflow. Mechanically attached to shaft with set screws.
- E. Blower section motor source quality control: Factory test blower performance for flow rate, pressure, power, air density, rotation speed and efficiency, in accordance with AMCA 210, "Laboratory Methods of Testing Fans for Rating".

#### **2.05 MOTORS**

- A. General: Provide NEMA Premium Efficiency motors for blower motors greater than 3/4 horsepower. Size drives for a minimum of 150 percent of driven horsepower and provide fully machined cast-type pulleys, keyed and secured to the fan wheel and motor shafts. Provide an adjustable drive pulley for motors of ten horsepower or less. Where shown on Drawings, provide unit with variable frequency drive.

#### **2.06 UNIT CONTROLS**

- A. Provide gas furnace with DDC controller for full modulation of gas furnace. Controller to connect with unit's integral controller for capacity control, or receive signals from BMS for control of gas furnace's discharge air temperature setpoint.
- B. Provide a stand-alone heating and cooling system controlled by factory-supplied DDC controllers, thermostats and sensors.
- C. Provide terminals and a DDC controller to allow the unit to be operated as a heating and cooling system controlled by a Building Management System (BMS).
- D. Provide a DDC controller with integral LCD screen that provides text readouts of status, operating settings and alarm conditions. Provide DDC controller with built-in keypad to permit operator to access read-out screens and change settings without the use of ancillary equipment, devices or software. Where required, provide all external hardware and software

necessary for view and change settings. Factory-program the DDC controller for communication with the BMS via BACnet protocol, for start/stop and monitoring of the unit's status. Provide the following sensors for functioning of the unit:

1. Space Temperature Sensors
  2. Heating Inlet Air temperature Sensor
  3. Cooling Inlet Air temperature Sensor
  4. Dirty Filter Sensor
  5. For projects without a Fire Alarm Control Panel, Smoke Detector for unit shut down.
- E. Variable Frequency Drive (VFD): Provide unit with factory installed variable frequency drives for modulation of the blower motors. Factory-program the VFDs for unit-specific requirements without requirement for additional field programming.

## **2.07 FILTERS**

- A. Provide units with 4-inch deep, MERV 13 disposable pleated filters located in the outdoor air intake and accessible from the exterior of the unit. For units with return air, locate the filter downstream of the mixing box.

## **PART 3 - EXECUTION**

### **3.01 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory authorized service representative to inspect field assembled components and equipment installation, to include electrical and piping connections. Report results to Architect and Engineer in writing. Inspection must include a complete startup checklist to include (as a minimum) the following: Completed Start-Up Checklists as found in manufacturer's Operation and Maintenance Manuals.

### **3.02 START-UP SERVICE**

- A. Engage a factory authorized service representative to perform startup service. Clean entire unit, comb coil fins as necessary, and install clean filters. Verify water source for compliance with manufacturer's requirements for flow and temperature. Measure and record electrical values for voltage and amperage. Refer to Section 23 05 93, Testing, Adjusting, and Balancing for HVAC, and comply with provisions therein.

### **3.03 DEMONSTRATION AND TRAINING**

- A. Engage a factory authorized service representative to train owner's maintenance personnel to adjust, operate and maintain the entire unit.

**END OF SECTION**



**SECTION 238126**  
**SMALL SPLIT SYSTEM AND UNITARY HVAC EQUIPMENT**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included: Materials, installation and testing of:
  - 1. Ductless Split Systems - Cooling Only

**1.02 RELATED SECTIONS**

- A. Contents of Section 23 00 00, HVAC Basic Requirements and Division 1, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 1, General Requirements.
- B. In addition, meet the following:
  - 1. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 1, General Requirements.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 1, General Requirements.
- B. In addition, meet the following:
  - 1. Efficiency ratings, cooling/heating performance, fan performance, sound performance to meet or exceed Basis of Design as scheduled on Drawings.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 1, General Requirements.
- B. In addition, provide:
  - 1. Refrigeration compressor(s): 5-year warranty.
  - 2. Furnace heat exchanger: 5-year warranty.

**PART 2 - PRODUCTS**

**2.01 DUCTLESS SPLIT SYSTEMS - COOLING ONLY**

- A. Manufacturers:
  - 1. Mitsubishi
  - 2. Sanyo
  - 3. Daikin Applied
  - 4. LG
  - 5. Friedrich
  - 6. Fujitsu
- B. Description: Self-contained, matched factory-engineered and assembled. Pre-wired indoor and outdoor units. UL/ETL listed.
- C. Outdoor Unit:
  - 1. Self contained, consisting of cabinet, compressor system, condenser fan matched to indoor unit.
  - 2. Cabinet: Fabricated of galvanized steel, bonderized, and finished with powder coated baked enamel.

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3. Refrigerant System:
    - a. HFC refrigerant or other refrigerant with zero ozone depletion potential (ODP).
    - b. Compressor: To be inverter driven, hermetic rotary type.
  4. Air System:
    - a. Fan: Propeller Type with one direct drive, inverter driven, variable speed motor.
    - b. Motor: Premium efficiency with inherent protection, permanently lubricated bearings and variable speed drive compatible.
    - c. Coil: Copper tubes and aluminum fins, coated for corrosion protection.
  5. Controls: Single source for both indoor and outdoor units, with low/high pressure switch, capable of communicating to/from the building DDC control system.
- D. Indoor Unit(s):
1. Self contained wall mounted, ceiling mounted or recessed ceiling mounted evaporator unit(s) as shown on Drawings, matched to outdoor unit.
  2. Cabinet:
    - a. Non-flammable, high impact polymer with a white finish.
    - b. Power Source: To be a single point power connection or sub-fed from outdoor condensing unit.
  3. Refrigeration System: HFC refrigerant or other refrigerant with zero ozone depletion potential (ODP).
  4. Air System:
    - a. Fan: An assembly with one or two inline fan(s) with a single direct drive motor.
    - b. Filter: Polypropylene, furnished with the unit, removable and washable.
    - c. Coil: Direct expansion type with copper tubes mechanically bonded into aluminum fins.
  5. Condensate Drain:
    - a. Provide drain pan sloped to drain away from unit. Drain pan with a single drain connection.
    - b. Condensate pump kit provided with unit.
    - c. Secondary drain pan; Condensate overflow shut-off float switch and external alarm.
  6. Controls: Wired thermostat. Control to be integral with unit.

### **PART 3 - EXECUTION**

#### **3.01 GENERAL INSTALLATION REQUIREMENTS**

- A. Install with required clearances and access for maintenance.
- B. Install factory furnished devices for field installation.
- C. Inspect for and remove shipping bolts, blocks and tie-down straps.
- D. After energizing units: Test units for proper fan rotation. Test and adjust controls and internal safeties. Replace malfunctioning units and retest.
- E. Thoroughly clean exposed portions of equipment. Install new filters prior to final test and balance and again prior to final acceptance.
- F. Provide vibration isolation: As scheduled.
- G. Provide seismic restraint.
- H. Condensate drain per manufacturer's piping diagram.
- I. Condensate piped to indirect waste connection; cleanouts at changes of direction; sized and sloped to drain per Code. Secondary drain routed to visible location or fan coil equipped with automatic shutoff when water level exceeds threshold.

**END OF SECTION**

**SECTION 238200**  
**TERMINAL HEAT TRANSFER EQUIPMENT**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Electric Wall Heaters

**1.02 RELATED SECTIONS**

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as outlined in Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

**PART 2 - PRODUCTS**

**2.01 ELECTRIC WALL HEATERS**

- A. Manufacturers:
  - 1. Trane
  - 2. Markel
  - 3. Qmark
  - 4. Chromalox
  - 5. Indeeco
- B. Description: Wall mounted forced air unit heater, including enclosure for surface or recessed mounting, fan and motor, heating elements and wall box. UL listed and wired per NEC.
- C. Cabinet: 20 gauge zinc coated steel, 16 gauge painted exterior grille.
- D. Fan and Motor: Propeller type fan, totally enclosed motor with permanently lubricated bearings and thermal overload protection, vandal proof.
- E. Heating Element: Sealed tubular type with finned heating elements, manual reset thermal limit safety switch, fan purge limit to dissipate residual heat on heater shutdown.
- F. Control:
  - 1. Control specified in Section 23 09 00, Instrumentation and Control Performance Specifications.

**PART 3 - EXECUTION**

**3.01 GENERAL INSTALLATION REQUIREMENTS**

- A. Avoid interference with structure and with work of other trades, preserving adequate headroom and clearing doors and passageways. Check each piece of equipment for defects, verifying that items function properly and that adjustments have been made.

- B. Prior to acceptance, thoroughly clean exposed portions of terminal heat transfer equipment, remove shipping labels and traces of foreign substance. Touch up scratched surfaces of radiant panels with factory matching paint.

**3.02 ELECTRIC WALL HEATERS INSTALLATION**

- A. Damaged Coils: Make every effort to prevent damage to both built-up coils and coils of packaged equipment. Comb damaged coil fins to be straight.
- B. Install per manufacturer's instructions. Comply with NEC and UL listings.
- C. Install heaters in place with box trim flush with finished wall.
- D. Install thermostat as shown on drawings. Provide control wiring from thermostat to unit.

**END OF SECTION**

**SECTION 260000**  
**ELECTRICAL BASIC REQUIREMENTS**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Work included in 26 00 00, Electrical Basic Requirements applies to Division 26, Electrical work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of electrical systems for proposed project.
- B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.
- C. Definitions:
  - 1. Provide: To furnish and install, complete and ready for intended use.
  - 2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
  - 3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work furnished.
  - 4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent", substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.
  - 5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's Authorized Representative, and other reviewing entity whose approval is required to obtain systems acceptance.

**1.02 RELATED SECTIONS**

- A. Contents of Section applies to Division 26, Electrical Contract Documents.
- B. Related Work:
  - 1. Additional conditions apply to this Division including, but not limited to:
    - a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
    - b. Drawings
    - c. Addenda
    - d. Owner/Architect Agreement
    - e. Owner/Contractor Agreement
    - f. Codes, Standards, Public Ordinances and Permits

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, individual Division 26, Electrical Sections and those listed in this Section.
- B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:
  - 1. State of Oregon:
    - a. OAR - Oregon Administrative Rules
    - b. 2021 OESC - Oregon Electrical Specialty Code
    - c. 2019 OFC - Oregon Fire Code
    - d. 2019 OMSC - Oregon Mechanical Specialty Code
    - e. 2021 OPSC - Oregon Plumbing Specialty Code

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- f. 2019 OSSC - Oregon Structural Specialty Code
  - g. 2021 OEESC - Oregon Energy Efficiency Specialty Code
  - h. 2011 Oregon Elevator Specialty Code
- C. Reference standards and guidelines include but are not limited to the latest adopted editions from:
- 1. ABA - Architectural Barriers Act
  - 2. ADA - Americans with Disabilities Act
  - 3. ANSI - American National Standards Institute
  - 4. APWA - American Public Works Association
  - 5. ASCE - American Society of Civil Engineers
  - 6. ASHRAE Guideline 0, the Commissioning Process
  - 7. ASTM - ASTM International
  - 8. CFR - Code of Federal Regulations
  - 9. EPA - Environmental Protection Agency
  - 10. ETL - Electrical Testing Laboratories
  - 11. FCC - Federal Communications Commission
  - 12. FM - FM Global
  - 13. IBC - International Building Code
  - 14. IEC - International Electrotechnical Commission
  - 15. IEEE - Institute of Electrical and Electronics Engineers
  - 16. IES - Illuminating Engineering Society
  - 17. ISO - International Organization for Standardization
  - 18. MSS - Manufacturers Standardization Society
  - 19. NEC - National Electric Code
  - 20. NECA - National Electrical Contractors Association
  - 21. NEMA - National Electrical Manufacturers Association
  - 22. NETA - National Electrical Testing Association
  - 23. NFPA - National Fire Protection Association
  - 24. OSHA - Occupational Safety and Health Administration
  - 25. UL - Underwriters Laboratories Inc.
- D. See Division 26, Electrical individual Sections for additional references.

#### 1.04 SUBMITTALS

- A. See Division 01, General Requirements for Submittal Procedures as well as individual Division 26, Electrical Sections.
- B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.
- C. In addition:
  - 1. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.
  - 2. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via zip file via e-mail. For electronic format, provide one file per division containing one bookmarked PDF file with each bookmark corresponding to each Specification Section. Arrange bookmarks in ascending order of Specification Section number. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. All transmissions/submissions to be submitted to Architect. Deviations will be returned without review.

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- a. Provide separate submittals for power system study (per Specification Section 26 05 73) and electrical equipment (for example, switchboards and panelboards).
- b. Provide separate submittals for lighting control cutsheets, and for lighting control shop drawings.
3. Product Data: Provide manufacturer's descriptive literature for products specified in Division 26, Electrical Sections.
4. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the specifications and drawings.
  - a. Label submittal to match numbering/references as shown in Contract Documents. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
  - b. Include technical data, installation instructions and dimensioned drawings for products, fixtures, equipment and devices installed, furnished or provided. Reference individual Division 26, Electrical specification Sections for specific items required in product data submittal outside of these requirements.
  - c. See Division 26, Electrical individual Sections for additional submittal requirements outside of these requirements.
5. Maximum of two reviews of complete submittal package. Arrange for additional reviews and/or early review of long-lead items; Bear costs of these additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.
6. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer's comments. Identify Engineer's comments and provide an individual response to each of the Engineer's comments. Cloud changes in the submittals and further identify changes which are in response to Engineer's comments.
7. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet ASCE 7-16 requirements for non-structural components. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.
8. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required per Division 26, Electrical Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical submittals. Electric motors are supplied and installed by Division 23 unless otherwise specified. During shop drawing stage of the project, verify correct disconnect sizes, conductor sizes, etc., and bring any discrepancies to the attention of the Mechanical trade. Be responsible for any modifications to electrical equipment or installations as a result of equipment incompatibility discovered after shop drawing review.
9. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.
10. Substitutions and Variation from Basis of Design:
  - a. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
  - b. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of

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- that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals". For any product marked "or approved equivalent", a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.
11. Shop Drawings: Provide coordinated shop drawings which include physical characteristics of all systems, device layout plans, and control wiring diagrams. Reference individual Division 26, Electrical specification Sections for additional requirements for shop drawings outside of these requirements.
    - a. Provide Shop Drawings indicating access panel locations, size and elevation for approval prior to installation.
  12. Samples: Provide samples when requested by individual Sections.
  13. Resubmission Requirements:
    - a. Make any corrections or change in submittals when required. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Cloud changes in the submittals.
    - b. Resubmit for review until review indicates no exception taken or "make corrections as noted".
  14. Operation and Maintenance Manuals, Owner's Instructions:
    - a. Submit, at one time, electronic files (PDF format) of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.
      - 1) Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
      - 2) Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, quantities, relevant to each piece of equipment.
      - 3) Include Warranty per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
      - 4) Include product certificates of warranties and guarantees.
      - 5) Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub assemblies.
      - 6) Include commissioning reports.
      - 7) Include copy of startup and test reports specific to each piece of equipment.
      - 8) Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.
    - b. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable



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- training aids and systems demonstrations. Field instruction per Section 26 00 00, Electrical Basic Requirements, Demonstration.
- c. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.
15. Record Drawings:
- a. Maintain at site at least one set of drawings for recording "As-constructed" conditions. Indicate on drawings changes to original documents by referencing revision document, and include buried elements, location of conduit, and location of concealed electrical items. Include items changed by field orders, supplemental instructions, and constructed conditions.
  - b. Record Drawings are to include equipment and fixture/connection schedules that accurately reflect "as constructed or installed" for project.
  - c. At completion of project, input changes to original project on CAD Drawings and make one set of black-line drawings created from CAD Files in version/release equal to contract drawings. Submit CAD Files and drawings upon substantial completion.
  - d. See Division 26, Electrical individual Sections for additional items to include in record drawings.

#### 1.05 QUALITY ASSURANCE

- A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.
- B. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.
- C. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturer's equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e. distribution equipment, duct banks, light fixtures, etc.) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.
- D. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.
- E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.
- F. Provide products that are UL listed.

#### 1.06 WARRANTY

- A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty under Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

### **1.07 COORDINATION DOCUMENTS**

- A. Prior to construction, prepare and submit coordinated layout drawings (composite drawings), to coordinate installation and location of HVAC equipment, ductwork, grilles, diffusers, piping, plumbing equipment/fixtures, fire sprinklers, plumbing, lights, cable tray and electrical services with architectural and structural requirements, and other trades (including plumbing, fire protection, electrical, ceiling suspension, and tile systems), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence.
- B. Prepare Drawings as follows:
  - 1. Drawings in CAD Format. CAD format release equal to design documents. Drawings to be same sheet size and scale as Contract Drawings and indicate location, size and elevation above finished floor of equipment and distribution systems.
  - 2. Review and revise, as necessary, section cuts in Contract Drawings after verification of field conditions.
  - 3. Incorporate Addenda items and change orders.
  - 4. Provide additional coordination as requested by other trades.
- C. Advise Architect in event conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.
- D. Verify in field exact size, location, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.
- E. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer.

### **2.02 STANDARDS OF MATERIALS AND WORKMANSHIP**

- A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL or ETL listed and labeled or be approved by State, County, and City authorities prior to procurement and installation.
- B. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
- C. Hazardous Materials:
  - 1. Comply with local, State of Oregon, and Federal regulations relating to hazardous materials.
  - 2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
  - 3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

### **2.03 ACCESS PANELS**

- A. See Division 01, General Requirements and Division 08, Openings for products and installation requirements.
- B. Confirm Access Panel requirements in Division 01, General Requirements, Division 08, Openings and individual Division 26, Electrical Sections. In the absence of specific requirements, comply with the following:

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1. Provide flush mounting access panels for service of systems and individual components requiring maintenance or inspection. Where access panels are located in fire-rated assemblies of building, rate access panels accordingly.
  - a. Ceiling access panels to be minimum of 24-inch by 24-inch.
  - b. Wall access panels to be minimum of 12-inch by 12-inch.
  - c. Provide screwdriver operated catch.
  - d. Manufacturers and Models:
    - 1) Drywall: Karp KDW.
    - 2) Plaster: Karp DSC-214PL.
    - 3) Masonry: Karp DSC-214M.
    - 4) 2 hour rated: Karp KPF-350FR.
    - 5) Manufacturers: Milcor, Elmdor, Acudor, or approved equivalent.

### **PART 3 - EXECUTION**

#### **3.01 ACCESSIBILITY AND INSTALLATION**

- A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- B. Install equipment requiring access (i.e., junction boxes, light fixtures, power supplies, motors, etc.) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in passageways, doorways, scuttles or crawlspaces which would impede or block the intended usage.
- C. Install equipment and products complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing, and coordination with other trades and disciplines.
- D. Earthwork:
  1. Confirm Earthwork requirements in Contract Documents. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
    - a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with related earthwork Sections. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
    - b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
    - c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.
- E. Firestopping:
  1. Confirm requirements in Division 07, Thermal and Moisture Protection. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
    - a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- F. Plenums:
  1. In plenums, provide plenum rated materials that meet the requirements to be installed in plenums. Immediately notify Architect/Engineer of discrepancy.

- G. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- H. Provide miscellaneous supports/metals required for installation of equipment and conduit.

### **3.02 SEISMIC CONTROL**

- A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, and individual Division 26 Electrical Sections.
- B. General:
  - 1. Earthquake resistant designs for Electrical (Division 26) equipment and distribution, i.e. power distribution equipment, generators, UPS, etc. to conform to regulations of jurisdiction having authority.
  - 2. Restraints which are used to prevent disruption of function of piece of equipment because of application of horizontal force to be such that forces are carried to frame of structure in such a way that frame will not be deflected when apparatus is attached to a mounting base and equipment pad, or to structure in normal way, utilizing attachments provided. Secure equipment and distribution systems to withstand a force in direction equal to value defined by jurisdiction having authority.
  - 3. Provide stamped shop drawings from licensed Structural Engineer of seismic bracing and seismic movement assemblies for conduit and equipment. Submit shop drawings along with equipment submittals.
  - 4. Provide stamped shop drawings from licensed Structural Engineer of seismic flexible joints for conduit crossing building expansion or seismic joints. Submit shop drawings along with seismic bracing details.
  - 5. Provide means to prohibit excessive motion of electrical equipment during earthquake.

### **3.03 REVIEW AND OBSERVATION**

- A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:
  - 1. Underground conduit installation prior to backfilling.
  - 2. Prior to covering walls.
  - 3. Prior to ceiling cover/installation.
  - 4. When main systems, or portions of, are being tested and ready for inspection by AHJ.
- C. Final Punch:
  - 1. Prior to requesting a final punch visit from the Engineer, request from Engineer the Electrical Precloseout Checklist, complete the checklist confirming completion of systems' installation, and return to Engineer. Request a final punch visit from the Engineer, upon Engineer's acceptance that the electrical systems are ready for final punch.
  - 2. Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

### **3.04 CONTINUITY OF SERVICE**

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements in Division 01, General Requirements, comply with individual Division 26, Electrical Sections and the following:
  - 1. During remodeling or addition to existing structure, while existing structure is occupied, present services to remain intact until new construction, facilities or equipment is installed.
  - 2. Prior to changing over to new service, verify that every item is thoroughly prepared. Install new wiring, and wiring to point of connection.

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3. Coordinate transfer time to new service with Owner. If required, perform transfer during off-peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum.
  - a. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
4. No interruption of services to any part of existing facilities will be permitted without express permission in each instance from Owner. Requests for outages must state specific dates, hours and maximum durations, with outages kept to these specific dates, hours and maximum durations. Obtain written permission from Owner for any interruption of power, lighting or signal circuits and systems.
  - a. Organize work to minimize duration of power interruption.
  - b. Coordinate utility service outages with utility company.

### **3.05 CUTTING AND PATCHING**

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements in Division 01, General Requirements, comply with individual Division 26, Electrical Sections and the following:
  1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
  2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.
  3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.
  4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of this project. Where alterations disturb lawns, paving, and/or walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.
  5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

### **3.06 EQUIPMENT SELECTION AND SERVICEABILITY**

- A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.

### **3.07 DELIVERY, STORAGE AND HANDLING**

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
  1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust. Products and/or materials that become damaged due to water, dirt, and/or dust as a result of improper storage and handling to be replaced before installation.
  2. Protect equipment to avoid damage. Close conduit openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
  3. Protect bus duct and similar items until in service.

### **3.08 DEMONSTRATION**

- A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, and individual Division 26, Electrical Sections.
- B. Upon completion of work and adjustment of equipment, test systems and demonstrate to Owner's Authorized Representative, Architect, and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

### **3.09 CLEANING**

- A. Confirm Cleaning requirements in Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- B. Upon completion of installation, thoroughly clean electrical equipment, removing dirt, debris, dust, temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

### **3.10 INSTALLATION**

- A. Confirm Installation requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- B. Install equipment and fixtures in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.
- C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- D. Provide miscellaneous supports/metals required for installation of equipment.

### **3.11 PAINTING**

- A. Confirm requirements in Division 01, General Requirements and Division 09, Finishes. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
  - 1. Ferrous Metal: After completion of work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces (i.e., hangers, hanger rods, equipment stands, etc.) with one coat of black asphalt varnish for exterior or black enamel for interior, suitable for hot surfaces.
  - 2. In Electrical Room, on roof or other exposed areas, equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
  - 3. See individual equipment Specifications for other painting.
  - 4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
  - 5. Conduit: Clean, primer coat and paint interior/exterior conduit exposed in public areas with two coats paint suitable for metallic surfaces. Color selected by Architect.

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6. Covers: Covers such as manholes, vaults and the like will be furnished with finishes which resist corrosion and rust.

### 3.12 ACCESS PANELS

- A. Confirm Access Panel requirements in Division 01, General Requirements. In the absence of specific requirements in Division 01, General Requirements, comply with individual Division 26, Electrical Sections and the following:
  1. Coordinate locations/sizes of access panels with Architect prior to work.

### 3.13 DEMOLITION

- A. Confirm requirements in Division 01, General Requirements and Division 02, Existing Conditions. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
  1. It is the intent of these documents to provide necessary information and adjustments to electrical system required to meet code, and accommodate installation of new work.
  2. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access or access to different areas. Owner will cooperate to best of their ability to assist in coordinated schedule, but will remain final authority as to time of work permitted.
  3. Examination:
    - a. Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to locate and preserve utilities. Replace damaged items with new material to match existing.
    - b. Verify that abandoned wiring and equipment serve only abandoned facilities.
    - c. Demolition drawings are based on casual field observation and existing record documents.
      - 1) Verify accuracy of information shown prior to bidding and provide such labor and material as is necessary to accomplish work.
      - 2) Verify location and number of electrical outlets, luminaires, panels, etc. in field.
    - d. Report discrepancies to Architect before disturbing existing installation.
      - 1) Promptly notify Owner if utilities are found which are not shown on Drawings.
  4. Execution:
    - a. Remove existing luminaires, switches, receptacles, and other electrical equipment and devices and associated wiring from walls, ceilings, floors, and other surfaces scheduled for remodeling, relocation, or demolition unless shown as retained or relocated on Drawings.
    - b. Provide temporary wiring and connections to maintain electrical continuity of existing systems during construction. Remove or relocate electrical boxes, conduit, wiring, equipment, and luminaires, as encountered in removed or remodeled areas in existing construction affected by this work.
    - c. Remove and restore wiring which serves usable existing outlets clear of construction or demolition.
    - d. If existing junction boxes will be made inaccessible, or if abandoned outlets serve as feed through boxes for other existing electrical equipment which is being retained, provide new conduit and wire to bypass inaccessible junction boxes and abandoned outlets.
    - e. If existing conduits pass through partitions or ceiling which are being removed or remodeled, provide new conduit and wire to reroute clear of construction or demolition and maintain service to existing load.
    - f. Extend circuiting and devices in existing walls to be furred out.
    - g. Remove abandoned wiring to source of supply.
    - h. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

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- i. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
- j. Disconnect and remove abandoned panelboards and distribution equipment.
- k. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- l. Existing lighting which is to remain, leave luminaires in proper working order.
- m. Repair adjacent construction and finishes damaged during demolition work.
- n. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

### **3.14 ACCEPTANCE**

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
  - 1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
    - a. Cleaning
    - b. Operation and Maintenance Manuals
    - c. Training of Operating Personnel
    - d. Record Drawings
    - e. Warranty and Guaranty Certificates
    - f. Start-up/Test Document and Commissioning Reports

### **3.15 FIELD QUALITY CONTROL**

- A. Confirm Field Quality Control requirements in Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- B. Tests:
  - 1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in operation and maintenance manuals.
  - 2. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

### **3.16 LETTER OF CONFORMANCE**

- A. Provide Letter of Conformance, copies of manufacturers' warranties and extended warranties with a statement that Electrical items were installed in accordance with manufacturer's recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in Operation and Maintenance Manuals.

### **3.17 SALVAGED EQUIPMENT AND RECYCLED MATERIAL**

- A. Salvage the following equipment not being reused and return to Owner:
  - 1. Luminaires
  - 2. Breakers
- B. Electrical equipment that cannot be salvaged for reuse, sell/give to recycling company. Recycle following excess, removed, or demolished electrical material:
  - 1. Copper or aluminum conductors, buses, and motor/transformer windings.
  - 2. Steel and aluminum from raceways, boxes, enclosures, and housings.
  - 3. Acrylic and glass from luminaire lenses/refractors.
- C. Provide separate on-site storage space for recycled and salvaged material. Clearly label space.
- D. Confirm additional salvaged equipment and recycled materials in the Contract Documents.



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**END OF SECTION**

**SECTION 260501  
ELECTRICAL DEMOLITION**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Materials and Equipment

**1.02 RELATED SECTIONS**

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**PART 2 - PRODUCTS**

**2.01 MATERIALS AND EQUIPMENT**

- A. Materials and equipment for patching and extending work: As specified in individual Sections.

**PART 3 - EXECUTION**

**3.01 EXAMINATION**

- A. Verify that field measurements and circuiting arrangements are as shown on Drawings.
- B. Determine the exact location of existing utilities and equipment before commencing work, compensate the Owner for damages caused by the failure to locate and preserve utilities. Replace damaged items with new material to match existing.
- C. Verify that abandoned wiring and equipment serve only abandoned facilities.
- D. Demolition drawings are based on casual field observation and existing record documents.
  - 1. Verify the accuracy of the information shown prior to bidding and provide such labor and material as is necessary to accomplish the work.
  - 2. Verify location and number of electrical outlets in the field.
- E. Report discrepancies to Owner before disturbing existing installation.
- F. Report discrepancies to Architect before disturbing existing installation.
- G. Beginning of demolition means installer accepts existing conditions without exception.

**3.02 PREPARATION**

- A. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access, and access to different areas. The Owner will cooperate to the best of their ability to assist in a coordinated schedule, but will remain the final authority as to time of work permitted.
- B. Disconnect electrical systems in walls, floors, and ceilings to be removed.

- C. Coordinate utility service outages with utility company.
- D. Interruption of services (power, telephone, fire alarm, communication systems) to existing facilities: not permitted without express permission in each instance from the Owner.
  - 1. Requests for service outages: State specific dates, hours and the maximum duration.
  - 2. Written permission: Obtain from Owner for interruption of power, lighting or signal circuits and systems.
  - 3. Organize the work to minimize duration of service interruptions.
  - 4. Provide temporary wiring and connections to maintain existing systems in service during construction.
- E. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- F. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections.
  - 1. Obtain permission from Owner at least 24 hours before partially or completely disabling system.
  - 2. Make temporary connections to maintain service in areas adjacent to work area.
- G. Overtime and shift work: Provide as required to maintain continuity of services during normal working hours of the occupied building.

### **3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK**

- A. Remove, relocate, and extend existing installations to accommodate new construction.
- B. Remove abandoned wiring to source of supply.
- C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- D. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
- E. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- F. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- G. Reroute wiring clear of demolition which serve existing outlets that remain and reconnect back to source.
- H. Repair adjacent construction and finishes damaged during demolition and extension work.
- I. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.
- J. Furred out walls/columns: extend circuiting and outlets.
- K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

### **3.04 CLEANING AND REPAIR**

- A. Clean and repair existing materials and equipment which remain or are to be reused.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
- C. Luminaires to remain: Remove luminaires for cleaning. Use mild detergent to clean exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts.

**3.05 SALVAGED EQUIPMENT AND RECYCLED MATERIAL**

- A. Salvage the following equipment not being reused and return to Owner:
  - 1. Luminaires
  - 2. Breakers
  - 3. Disconnects
- B. Salvage the following equipment not being reused and sell/give to electrical salvage company:
  - 1. Luminaires
  - 2. Breakers
  - 3. Disconnects
- C. Electrical equipment that cannot be salvaged for reuse sell/give to recycling company. Recycle the following excess, removed, or demolished electrical material:
  - 1. Copper or aluminum conductors, buses, motor/transformer windings, and the like.
  - 2. Steel and aluminum from raceways, boxes, enclosures, housings and the like.
  - 3. Acrylic and glass from luminaire lenses/refractors.
- D. Provide separate on-site storage space for recycled and salvaged material. Clearly label space.

**END OF SECTION**

**SECTION 260509  
EQUIPMENT WIRING**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Equipment connections, whether furnished by Owner or other Divisions of the Contract.

**1.02 RELATED SECTIONS**

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition:
  - 1. Verify mechanical and utilization equipment electrical characteristics with Drawings and equipment submittals prior to ordering equipment. Submit confirmation of this verification as a part of, or addendum to, the electrical product submittals.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements apply to this Section.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**PART 2 - PRODUCTS**

**2.01 MATERIALS**

- A. Materials and Equipment for Equipment Wiring: As specified in individual Sections.

**2.02 GENERAL**

- A. Unless otherwise noted, the following voltage and phase characteristics apply to motors:
  - 1. 3/4 HP and Under: 120 volt, 1 phase.
  - 2. 1 HP and Over: 208 volt, 3 phase.
  - 3. 1 HP and Over: 240 volt, 3 phase.
- B. Safety Switches: Provide as required by OESC and as specified in Section 26 28 16, Enclosed Switches and Circuit Breakers.

**PART 3 - EXECUTION**

**3.01 EXAMINATION**

- A. Prior to submittal of product data for electrical distribution equipment, obtain and examine product data and shop drawings for equipment furnished by the Owner and by other trades on the project. Update the schedule of equipment electrical connections accordingly, noting proper ratings for overcurrent devices, fuses, safety disconnect switches, conduit and wiring, and the like. As a minimum, this requirement applies to equipment furnished by Owner and equipment furnished under the following divisions of work under this contract:
  - 1. Division 8, Openings
  - 2. Division 11, Equipment
  - 3. Division 21, Fire Suppression

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4. Division 22, Plumbing
5. Division 23, HVAC, Heating, Ventilating and Air Conditioning
6. Division 27, Communications
7. Division 28, Electronic Safety and Security

**3.02 INSTALLATION**

- A. Do not install unrelated electrical equipment or wiring on mechanical equipment without prior approval of Engineer.
- B. Provide moisture tight equipment wiring and switches in ducts or plenums used for environmental air.
- C. Connect motor and appliance/utilization equipment complete from panel to motor/equipment as required by code.
- D. Install motor starters and controllers for equipment furnished by others.
- E. Appliance/Utilization Equipment:
  1. Provide appropriate cable and cord cap for final connection unless equipment is provided with same. Provide receptacle configured to receive cord cap.
  2. Verify special purpose outlet NEMA configuration and ampere rating with equipment supplier prior to ordering wiring devices and coverplates.

**3.03 FIELD QUALITY CONTROL**

- A. Perform field inspection and testing in accordance with Division 01, General Requirements.

**3.04 SYSTEMS STARTUP**

- A. Provide field representative to prepare and start equipment.
  1. Test and correct for proper rotation of polyphase motors.
- B. Adjust for proper operation within manufacturer's published tolerances.
- C. Demonstrate proper operation of equipment to Owner's Authorized Representative.

**END OF SECTION**

**SECTION 260519**  
**LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Lugs and Pads
  - 2. Wires and Cables
  - 3. Splices
  - 4. Connectors

**1.02 RELATED SECTIONS**

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Cable insulation test reports in project closeout documentation.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

- A. Lugs and Pads:
  - 1. Anderson
  - 2. IlSCO
  - 3. Panduit
  - 4. Thomas & Betts
  - 5. 3M
  - 6. Or approved equivalent.
- B. Wires and Cables:
  - 1. General:
    - a. General Cable
    - b. Okonite
    - c. Southwire
    - d. Encore Wire
    - e. Or approved equivalent.
  - 2. Metal Clad Cable - Type MC or Type HCF-MC:
    - a. Alflex
    - b. AFC
    - c. General Cable
    - d. Southwire

- e. Encore Wire
  - f. Or approved equivalent.
- C. Splices:
- 1. Branch Circuit Splices:
    - a. Ideal
    - b. 3M Scotchlok
    - c. Uraseal, Inc.
    - d. Or approved equivalent.
  - 2. Feeder Splices:
    - a. Not allowed.
- D. Connectors:
- 1. Anderson Power Products
  - 2. Burndy
  - 3. IIsco
  - 4. 3M
  - 5. Thomas & Betts
  - 6. Or approved equivalent.

**2.02 LUGS AND PADS**

- A. Ampacity: Cross-sectional area of pad for multiple conductor terminations to match ampere rating of panelboard bus or equipment line terminals.
- B. Copper Pads: Drilled and tapped for multiple conductor terminals.
- C. Lugs: Compression type for use with stranded branch circuit or control conductors; mechanical type for use with solid branch and feeder circuit conductors.

**2.03 WIRES AND CABLES**

- A. Building Wires:
  - 1. Copper: Soft-drawn with conductivity of not less than 98 percent IACS at 20 degrees C (68 degrees F). 600 volt rated throughout. Conductors 12 AWG and 10 AWG, solid or stranded. Conductors 8 AWG and larger, stranded. 12 AWG minimum conductor size. Minimum insulation rating of 90 degrees C. Insulation Type: THHN/THWN-2.
- B. Phase color to be consistent at feeder terminations; A-B-C, top to bottom, left to right, front to back.
- C. Color Code Conductors as Follows:

PHASE	208 VOLT WYE
A	Black
B	Red
C	Blue
Neutral	White
Ground	Green

- D. MC Cable:
  - 1. Standard: High strength galvanized steel flexible armor. Full length minimum size No. 12 copper ground wire, copper dual rated THHN/THWN-2, full length tape marker phase/circuit identification on cable armor. Short circuit throat insulators, mechanical compression termination.
  - 2. Hospital Care Facility: High strength galvanized steel flexible armor. Full length minimum size No. 10 copper ground wire, Conductors to be 600V rated, copper, THHN (90C). Provide full length tape marker phase/circuit identification and overall green finish on interlocked cable armor. Short circuit throat insulators, mechanical compression termination.



- E. AC Cable (Armored Cable): Not allowed.
- F. NMB Cable: Not allowed.

#### **2.04 SPLICES**

- A. Branch Circuits: Twist on, high temperature, grounding type wing nuts.
  - 1. Ideal Industries Wing-Nut Twist-On Connectors.
  - 2. 3M Scotchlok Twist-On Wire Connectors.
- B. Feeders:
  - 1. Feeder splices not allowed.

#### **2.05 CONNECTORS**

- A. Split bolt connectors not allowed.
- B. Conductor Branch Circuits: Wire nuts with integral spring connectors for conductors 12 AWG through 8 AWG. Push-in type connectors where conductors are not required to be twisted together are not acceptable.

### **PART 3 - EXECUTION**

#### **3.01 GENERAL INSTALLATION REQUIREMENTS**

- A. Install per manufacturer instructions and OESC.
- B. Field Quality Control:
  - 1. Test conductor insulation on feeders of 100 amp and greater for conformity with 1000 volt megohmmeter. Use Insulated Cable Engineers Association testing procedures. Minimum insulation resistance acceptable is 1 megohm for systems 600 volts and below. Notify Architect if insulation resistance is less than 1 megohm.
  - 2. Test Report: Prepare a typed tabular report indicating the testing instrument, the feeder tested, amperage rating of the feeder, insulation type, voltage, the approximate length of the feeder, conduit type, and the measured resistance of the megohmmeter test. Submit test reports with project closeout documents.
  - 3. Inspect and test in accordance with NETA Standard ATS, except Section 4.
  - 4. Perform inspections and tests listed in NETA Standard ATS, Section 7.3.2.

#### **3.02 LUGS AND PADS**

- A. Thoroughly clean surfaces to remove all dirt, oil, grease or paint.
- B. Use torque wrench to tighten per manufacturer's directions.

#### **3.03 WIRES AND CABLES**

- A. General:
  - 1. Do not install or handle thermoplastic insulated wire and cable in temperatures below -10 degrees C (14 degrees F). Do not handle thermoset insulated wire and cable in temperatures below -40 degrees C (-40 degrees F). All wire and cable must be acclimated to temperatures above freezing for no less than 24 hours prior to installation.
  - 2. Install conductors in raceways having adequate, code size cross-sectional area for wires indicated.
  - 3. Install conductors with care to avoid damage to insulation.
  - 4. Do not apply greater tension on conductors than recommended by manufacturer during installation.
  - 5. Use of pulling compounds is permitted. Clean residue from exposed conductors and raceway entrances after conductor installation. Do not use pulling compounds for installation of conductors connected to GFCI circuit breakers or GFCI receptacles.
  - 6. Conductor Size and Quantity:
    - a. Install no conductors smaller than 12 AWG unless otherwise shown.
    - b. Provide required conductors for a fully operable system.

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- c. Power Circuits: No. 12 AWG minimum, except as follows:
  - 1) No. 10 AWG for 15A, 120V circuits longer than 100 ft.
  - 2) No. 8 AWG for 15A, 120V circuits longer than 150 ft.
  - 3) No. 10 AWG for 20A, 120V circuits longer than 70 ft.
  - 4) No. 8 AWG for 20A, 120V circuits longer than 100 ft.
- d. When exact run lengths are determined for all branch circuits, and prior to installation of the conductors, ensure that the maximum voltage drop, based on 80 percent of the circuit protective device, does not exceed 3 percent. Increase wire size from #12AWG, if necessary, to ensure that the 3 percent voltage drop is not exceeded.
- 7. Provide dedicated neutrals (one neutral conductor for each phase conductor) in all 120V circuits.
- B. Conductors in Cabinets:
  - 1. Cable and tree wires in panels and cabinets for power and control. Use plastic ties in panels and cabinets.
  - 2. Tie and bundle feeder conductors in wireways of panelboards.
  - 3. Hold conductors away from sharp metal edges.
- C. Homeruns:
  - 1. Do not change intent of branch circuit homeruns without approval. Homeruns for 20A branch circuits may be combined to a maximum of six current carrying conductors including neutral conductors in homeruns. Apply derating factors as required per NEC. Increase conductor size as needed.
  - 2. MC cable homeruns are not allowed unless indicated on drawings.
- D. Identify wire and cable under the provisions of Section 26 05 53, Identification for Electrical Systems. Identify each conductor with its panel and circuit number as indicated.
- E. Exposed cable is not allowed.
- F. All cable must be run parallel or perpendicular to building lines and hidden from view when possible. Where installed in tray each power cable is to be identified with Lamacoid nametag engraved with identification of equipment being fed. Tag to be fastened to cable using tie-wraps. Provide nametag at each floor level.
- G. Do not install PVC jacketed cables in return air plenums, unless they are specially rated plenum cables.
- H. Use of MC Cable is limited to the following conditions. Installations that do not comply with the following conditions are to be removed and replaced with no additional expense to the Owner.
  - 1. 15 and 20 amp branch wiring where following conditions apply:
    - a. Where there is a suspended ceiling with accessible space above (example: suspended acoustic ceiling tile).
    - b. MC cable may be routed in the void space above hard lid ceilings, and routed within wall cavities below glazing, provided OESC requirements are otherwise met, and a minimum one 0.75-inch conduit is routed from nearest accessible ceiling space to inaccessible location, terminating in a j-box with blank faceplate, for future circuits.

### 3.04 SPLICES

- A. Make splices complete and promptly after wire installation. Provide single wire pigtails for luminaire and device connections. Wire nuts may be used for luminaire wire connections to single wire circuit conductor pigtails.
- B. Make splices for No. 8 and larger wires with mechanically applied pressure type connectors. Make all taped joints with Scotch 33+ or equal, applied in half-lap layers without stretching to deform. Uraseal splice kits are also acceptable through 250 KCMIL.
- C. Remove insulation with a stripping tool designed specifically for that purpose. A pocket knife is not an acceptable tool. Leave all conductors nick-free.

**3.05 CONNECTORS**

- A. Install to assure a solid and safe connection.
- B. Select hand twist connectors for wire size and install tightly on conductors.
- C. Install compression connectors using methods and tools recommended by the manufacturer.
- D. Do not install stranded conductors under screw terminals unless compression lugs are installed.
- E. Do not connect wiring without UL listed connectors that are listed for the purposes.

**END OF SECTION**

**SECTION 260526**  
**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Grounding Electrodes
  - 2. Connectors and Accessories
  - 3. Grounding Conductor

**1.02 RELATED SECTIONS**

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Test reports of ground resistance for service and separately derived system grounds.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Comply with the requirements of ANSI/NFPA 70.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

- A. Grounding Electrodes:
  - 1. Erico
  - 2. Thomas & Betts
  - 3. Talley
  - 4. Or approved equivalent.
- B. Connectors and Accessories:
  - 1. Burndy Hyground Compression System
  - 2. Erico/Cadweld
  - 3. Amp Ampact Grounding System
  - 4. Pipe Grounding Clamp:
    - a. Burndy GAR Series
    - b. O Z Gedney
    - c. Thomas & Betts
    - d. Or approved equivalent.
- C. Grounding Conductor
  - 1. General Cable
  - 2. Okonite
  - 3. Southwire

4. Or approved equivalent

## **2.02 GROUNDING ELECTRODES**

- A. Ground Rods: Copper-clad steel, minimum 3/4-inch diameter, 10-feet long, tapered point, chamfered top.

## **2.03 CONNECTORS AND ACCESSORIES**

- A. Grounding Connectors: Hydraulic compression tool applied connectors or exothermic welding process connectors or powder actuated compression tool applied connectors.
- B. Pipe Grounding Clamp: Mechanical ground connector with cable parallel or perpendicular to pipe.

## **2.04 GROUNDING CONDUCTOR**

- A. Grounding Electrode Conductor: Soft-draw bare stranded copper for wire sizes larger than #10 AWG Bare. Solid copper for wire sizes #10 AWG and smaller.
- B. Equipment Grounding Conductor: Green insulated, insulation type to match that of associated feeder or branch circuit wiring, size as indicated on drawings.

## **PART 3 - EXECUTION**

### **3.01 GENERAL INSTALLATION REQUIREMENTS**

- A. Verify site conditions prior to beginning work.
- B. Bond Sections of service equipment enclosure to service ground bus.
- C. Separately Derived Systems: Ground each separately derived system per NEC Article 250.
- D. Corrosion inhibitors: Apply a corrosion inhibitor to contact surfaces when making grounding and bonding connections. Use corrosion inhibitor appropriate for protecting a connection between metals used.
- E. Grounding system resistance to ground not to exceed 5 ohms. Make necessary modifications or additions to grounding electrode system for compliance. Submit final tests to assure that this requirement is met.
- F. Resistance of grounding electrode system: measure using a four-terminal fall-of-potential method as defined in IEEE 81. Take ground resistance measurements before electrical distribution system is energized and in normally dry conditions, not less than 48 hours after last rainfall. Take resistance measurements of separate grounding electrode systems before systems are bonded together below grade. Combined resistance of separate systems may be used to meet required resistance, but specified number of electrodes must still be provided.
- G. Inspect and test in accordance with NETA Standard ATS, Except Section 4.
- H. Perform inspections and tests listed in NETA Standard AB, Section 7.13.

### **3.02 GROUNDING ELECTRODES INSTALLATION**

- A. Ground Rod Electrode:
1. Verify that final backfill and compaction have been completed before driving rod electrodes.
  2. Bond #6 grounding electrode conductor to driven ground rods as indicated on Drawings.
  3. Tap at center ground rod and extend grounding electrode conductor to service grounding bus. Install grounding electrode conductor to service grounding bus in rigid PVC conduit for physical protection where grounding electrode conductor passes through concrete floor or other concrete structure.
- B. Metal Underground Water Service: Bond water service pipe to service equipment ground bus or to the grounding electrode system. Connect to water pipe on utility side of isolating fittings or meters, bond across water meters.

- C. Other Metal Piping Systems: Bond gas piping system, fire sprinkler piping system and other metal piping systems to service equipment ground bus or to the grounding electrode system.
- D. Bond together metal siding not attached to grounded structure; bond to grounding electrode system.

### **3.03 CONNECTORS AND ACCESSORIES INSTALLATION**

- A. Install per manufacturer's instructions.

### **3.04 GROUNDING CONDUCTOR INSTALLATION**

- A. Raceways:
  - 1. Ground metallic raceway systems. Bond to ground terminal with code size jumper except where code size or larger equipment grounding conductor is included with circuit, use grounding bushing with lay-in lug.
  - 2. Connect metal raceways, which terminate within an enclosure but without mechanical connection to enclosure, by grounding bushings and ground conductor to grounding bus.
  - 3. Where equipment supply conductors are in flexible metallic conduit, install stranded copper equipment grounding conductor from outlet box to equipment frame.
  - 4. Install equipment grounding conductor, code size minimum unless noted on drawings, in metallic and nonmetallic raceway systems.
- B. Feeders and Branch Circuits:
  - 1. Provide continuous green insulated copper equipment grounding conductors for feeders and branch circuits.
  - 2. Where installed in a continuous solid metallic raceway system and larger sizes are not detailed, provide insulated equipment grounding conductors for feeders and branch circuits sized in accordance with the latest adopted edition of NEC Article 250, Table 250-122.
- C. Bond boxes, cabinets, enclosures and panelboard equipment grounding conductors to enclosure with specified conductors and lugs. Install lugs only on thoroughly cleaned contact surfaces.
- D. Motors, Equipment and Appliances: Install code size equipment grounding conductor to (motor) equipment frame or manufacturer's designated ground terminal.
- E. Receptacles: Connect ground terminal of receptacle and associated outlet box to equipment grounding conductor. Self grounding nature of receptacle devices does not eliminate equipment grounding conductor bolted to outlet box.

**END OF SECTION**

**SECTION 260529**  
**HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS AND EQUIPMENT**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Anchors, Threaded Rod and Fasteners
  - 2. Support Channel, Hangers and Supports
  - 3. Rooftop Conduit Supports

**1.02 RELATED SECTIONS**

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**1.04 SUBMITTALS**

- A. Submittals not required for this Section.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Manufacturers regularly engaged in the manufacture of bolted metal framing support systems, whose products have been in satisfactory use in similar service for not less than 10 years.
  - 2. Support systems to be supplied by a single manufacturer.
  - 3. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze, equipment hangers/supports, and seismic restraint by a qualified Structural Professional Engineer.
    - a. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design, and extent.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**1.07 PERFORMANCE REQUIREMENTS**

- A. General: Provide conduit and equipment hangers and supports in accordance with the following:
  - 1. When supports, anchorages, and seismic restraints for equipment and supports, anchorages and seismic restraints for conduit, cable tray and equipment are not shown on the Drawings, the Contractor is responsible for their design.
  - 2. Connections to structural framing shall not introduce twisting, torsion, or lateral bending in the framing members. Provide supplementary steel as required.
- B. Engineered Support Systems: The following support systems to be designed, detailed, and bear the seal of a professional engineer registered in the State of Oregon.
  - 1. Support frames such as conduit racks or stanchions for conduit and equipment which provide support from below.
  - 2. Equipment and piping support frame anchorage to supporting slab or structure.

- C. Provide channel support systems, for conduits to support multiple conduits capable of supporting combined weight of support systems and system contents.
- D. Provide heavy-duty steel trapezes for piping to support multiple conduit capable of supporting combined weight of supported systems and system contents.
- E. Provide seismic restraint hangers and supports for conduit and equipment.
- F. Obtain approval from AHJ for seismic restraint hanger and support system to be installed for piping and equipment.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Anchors, Threaded Rod and Fasteners:
  - 1. Anchor It
  - 2. Epcon System
  - 3. Hilti-Hit System
  - 4. Power Fast System
  - 5. Or approved equivalent.
- B. Support Channel, Hangers and Supports:
  - 1. B-Line
  - 2. Kindorf
  - 3. Superstrut
  - 4. Unistrut
  - 5. Or approved equivalent.
- C. Rooftop Conduit Supports:
  - 1. Cooper B-Line Dura-Block Rooftop Support Base
  - 2. Or approved equivalent.

### **2.02 ANCHORS, THREADED ROD AND FASTENERS**

- A. Anchors, Threaded Rod and Fasteners - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.
- B. Anchors and Fasteners:
  - 1. Plaster, and Gypsum Board Partitions: Use toggle bolts.
  - 2. Sheet Metal: Use sheet metal screws.
  - 3. Wood Elements: Use wood screws.
- C. Fasteners: Provide fasteners of types as required for assembly and installation of fabricated items; surface-applied fasteners are specified elsewhere.
- D. Bolts: Low carbon steel externally and internally threaded fasteners conforming with requirements of ASTM A307; include necessary nuts and plain hardened washers. For structural steel elements supporting mechanical material or equipment from building structural members or connection thereto, use fasteners conforming to ASTM A325.
- E. Miscellaneous Materials: Provide incidental accessory materials, tools, methods, and equipment required for fabrication.

### **2.03 SUPPORT CHANNEL, HANGERS AND SUPPORTS**

- A. Hangers and Supports - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.
  - 1. Channel Material: Carbon steel.
  - 2. Coating: Hot dip galvanized.
- B. Pipe Straps: Two-hole galvanized or malleable iron.
- C. Luminaire Chain: 90 lb. test with steel hooks.



- D. Miscellaneous Metal: Provide miscellaneous metal items specified hereunder, including materials, fabrication, fastenings and accessories required for finished installation, where indicated on Drawings or otherwise not shown on drawings that are necessary for completion of the project. The Contractor is responsible for their design.
  - 1. Fabricate miscellaneous units to size shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.
- E. Structural Shapes: Where miscellaneous metal items are needed to be fabricated from structural steel shapes and plates, provide members constructed of steel conforming with requirements of ASTM A36 or approved equivalent.
- F. Steel Pipe: Provide seamless steel pipe conforming to requirements of ASTM A53, Type S, Grade A, or Grade B. Weight and size required as specified.
- G. Miscellaneous Materials: Provide incidental accessory materials, tools, methods, and equipment required for fabrication.

#### **2.04 ROOFTOP CONDUIT SUPPORTS**

- A. Curb base made of 100 percent recycled rubber and polyurethane prepolymer with a uniform load
- B. Capacity of 500 pounds per linear foot of support.
- C. UV resistant.
- D. Steel Frame: Steel, 14 gauge strut galvanized per ASTM A653 or 12 gauge strut galvanized per ASTM A653 for bridge series.
- E. Continuous block channel supports with 1-inch gaps to allow water flow, bridge channel supports, extendable height channel supports and elevated single conduit supports.
- F. Attaching Hardware: Zinc-plated threaded rod, nuts and attaching hardware per ASTM B633 fastened directly into rubber material with weather resistant Type 12 lag screws.
- G. Provide load distribution plates when required for heavy loads.
- H. Finish: Black with safety yellow striping.
- I. Provide hot dipped galvanized components for items exposed to weather.

### **PART 3 - EXECUTION**

#### **3.01 GENERAL INSTALLATION REQUIREMENTS**

- A. Fabrication - Miscellaneous Metals
  - 1. General: Verify dimensions prior to fabrication. Form metal items to accurate sizes and configurations as indicated on Drawings and otherwise required for proper installation; make with lines straight and angles sharp, clean and true; drill, countersink, tap, and otherwise prepare items for connections with work of other trades, as required. Fabricate to detail of structural shapes, plates and bars; weld joints where practicable; provide bolts and other connection devices required. Include anchorages; clip angles, sleeves, anchor plates, and similar devices. Hot dipped galvanize after fabrication items installed in exterior locations. Set accurately in position as required and anchor securely to building construction. Construct items with joints formed for strength and rigidity, accurately machining for proper fit; where exposed to weather, form to exclude water.
  - 2. Finishes:
    - a. Ferrous Metal: After fabrication, but before erection, clean surfaces by mechanical or chemical methods to remove rust, scale, oil, corrosion, or other substances detrimental to bonding of subsequently applied protective coatings. For metal items exposed to weather or moisture, galvanize in manner to obtain G90 zinc coating in

accordance with ASTM A123. Provide other non-galvanized ferrous metal with one coat of approved rust-resisting paint primer, in manner to obtain not less than 1.0 mil dry film thickness. Touch-up damaged areas in primer with same material, before installation. Apply zinc coatings and paint primers uniformly and smoothly; leave ready for finish painting as specified elsewhere.

- b. Metal in contact with Concrete, Masonry and Other Dissimilar Materials: Where metal items are to be erected in contact with dissimilar materials, provide contact surfaces with coating of an approved zinc-chromate primer in manner to obtain not less than 1.0 mil dry film thickness, in addition to other coatings specified in these specifications.
- c. For Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A780.

### **3.02 ANCHORS, THREADED ROD AND FASTENERS INSTALLATION**

- A. Safety factor of 4 required for every fastening device or support for equipment installed. Supports to withstand four times the weight of equipment it supports.
- B. Do not use other trade's fastening devices as supporting means for luminaires, equipment or materials.
- C. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- D. Do not use supports or fastening devices to support other than one particular item.
- E. Securely suspend junction boxes, pull boxes or other conduit terminating housings located above suspended ceiling from floor above or roof structure to prevent sagging and swaying.
- F. Provide seismic bracing per OSSC requirements.
- G. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- H. Use spring lock washers under fastener nuts for strut.
- I. Cutting and Drilling
  - 1. Do not drill or cut structural members without prior permission from Architect.

### **3.03 SUPPORT CHANNEL, HANGERS AND SUPPORTS INSTALLATION**

- A. Install hangers and supports as required to adequately and securely support electrical system components, in a neat and workmanlike manner, as specified in NECA 1.
- B. Safety factor of 4 required for every fastening device or support for equipment installed. Supports to withstand four times the weight of equipment it supports.
- C. Verify mounting height of luminaires prior to installation when heights are not detailed.
- D. Install vertical support members for equipment and luminaires, straight and parallel to building walls.
- E. Install horizontal support members straight and parallel to ceilings or finished floor unless otherwise noted.
- F. Provide independent supports to structural member for luminaires, materials, or equipment installed in or on ceiling, walls or in void spaces or over suspended ceilings.
- G. Do not use other trade's fastening devices as supporting means for luminaires, equipment or materials.
- H. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- I. Do not use supports or fastening devices to support other than one particular item.
- J. Support conduits within 18-inches of outlets, boxes, panels, cabinets and deflections unless more stringently required by OESC.
- K. Maximum distance between supports not to exceed 8 foot spacing unless otherwise required by OESC.

- L. Support flexible conduits and metal clad cable within 12-inches of outlets, boxes, panels, cabinets and deflections unless otherwise required by OESC.
- M. Maximum distance between supports for flexible conduits and metal clad cable not to exceed 48-inches spacing unless otherwise required by OESC.
- N. Maximum distance between supports for rigid PVC conduits unless otherwise required by OESC is as follows:
  - 1. 1/2-inch or 3/4-inch and 1-inch conduit, 3-feet apart.
  - 2. 1-1/4-inch or 1-1/2-inch and 2-inch conduit, 4-feet apart.
  - 3. 2-1/2-inch and 3-inch conduit, 5-feet apart.
  - 4. 4-inch and 5-inch conduit, 6-feet apart.
  - 5. 6-inch conduit, 7-feet apart.
- O. Maximum distance between supports for auxiliary gutters and wireways unless otherwise required by OESC is as follows:
  - 1. Sheet metal auxiliary gutters and wireways - 4-feet apart horizontally and 10-feet vertically.
  - 2. Non-metallic auxiliary gutters and wireways - 30-inches apart horizontally and 3-feet vertically.
- P. Install strut hangers as instructed by strut manufacturer. Suspend strut hangers as instructed by strut manufacturer for the load, with a maximum spacing of 8-feet on center and within 2-feet of outlet box, cabinet, junction box or other channel raceway termination unless otherwise required by OESC.
- Q. Coordinate routing of conduit racks with materials and equipment installed by other trades. Where conduit racks are exposed to view, coordinate location and installation with Architect for optimal appearance.
- R. Securely suspend junction boxes, pull boxes or other conduit terminating housings located above suspended ceiling from floor above or roof structure to prevent sagging and swaying.
- S. Provide seismic bracing per OSSC requirements.
- T. Where service disconnects are mounted on building exterior, physically attach service disconnect to the building or structure served.
- U. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- V. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- W. Wet and Damp Locations:
  - 1. In wet and damp locations use steel channel supports to stand cabinets and panelboards 1-inch off wall.

### **3.04 ROOFTOP CONDUIT SUPPORTS INSTALLATION**

- A. Consult roofing manufacturer for roof membrane compression capacities. If necessary, provide a compatible sheet of roofing material (rubber pad) under rooftop support to disperse concentrated loads and add further membrane protection.
- B. Do not use supports that will void roof warranty.
- C. Install supports per manufacturer's instructions and recommendations.
- D. Use properly sized clamps to suit conduit sizes.
- E. Install supports for rooftop raceways to raise raceways a minimum of 7/8-inches above the roof structure unless otherwise noted.

**END OF SECTION**

**SECTION 260533  
RACEWAYS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Rigid Metal Conduit (RMC)
  - 2. Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Metal Conduit
  - 3. Electrical Metallic Tubing (EMT)
  - 4. Flexible Metal Conduit (FMC)
  - 5. Liquidtight Flexible Metal Conduit (LFMC)
  - 6. Electrical Polyvinyl Chloride (PVC) Conduit
  - 7. Conduit Fittings
- B. Provide a complete system of conduit and fittings, with associated couplings, connectors, and fittings, as shown on Drawings and described in these Specifications.

**1.02 RELATED SECTIONS**

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
  - 1. Section 26 05 29, Hangers and Supports for Electrical Systems and Equipment
  - 2. Section 26 05 34, Boxes

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**1.07 DEFINITIONS**

- A. Raceway system is defined as consisting of conduit, tubing, duct, and fittings including but not limited to connectors, couplings, offsets, elbows, bushings, expansion/deflection fittings, and other components and accessories. Complete electrical raceway installation before starting the installation of conductors and cables.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

- A. Rigid Metal Conduit (RMC):
  - 1. Allied Tube & Conduit
  - 2. Beck Manufacturing Inc.
  - 3. Picoma
  - 4. Wheatland Tube Company
  - 5. Or approved equivalent.
- B. Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit:
  - 1. Allied Tube & Conduit

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2. Thomas & Betts Corporation
  3. Robroy Industries
  4. O'kote Inc.
  5. Or approved equivalent.
- C. Electrical Metallic Tubing (EMT):
1. Allied Tube & Conduit
  2. Beck Manufacturing WL
  3. Picoma
  4. Wheatland Tube Company
  5. Or approved equivalent.
- D. Flexible Metal Conduit (FMC):
1. AFC Cable Systems Inc.
  2. Electri-Flex Company
  3. International Metal Hose
  4. Or approved equivalent.
- E. Liquidtight Flexible Metal Conduit (LFMC):
1. AFC Cable Systems Inc.
  2. Electri-Flex Company
  3. International Metal Hose
  4. Or approved equivalent.
- F. Electrical Polyvinyl Chloride (PVC) Conduit:
1. AFC Cable Systems Inc.
  2. Electri-Flex Company
  3. International Metal Hose
  4. JM Eagle
  5. Or approved equivalent.
- G. Conduit Fittings:
1. Bushings:
    - a. Insulated Type for Threaded Raceway Without Factory Installed Plastic Throat Conductor Protection:
      - 1) Thomas & Betts 1222 Series
      - 2) O-Z Gedney B Series
      - 3) Or approved Equivalent.
  2. Raceway Connectors and Couplings:
    - a. Thomas & Betts Series
    - b. O-Z Gedney Series
    - c. Or approved Equivalent.
  3. Expansion/Deflection Fittings:
    - a. EMT: O-Z Gedney Type TX
    - b. RMC: O-Z Gedney Type AX, DX and AXDX, Crouse & Hinds XD
    - c. PVC: O-Z Gedney Type DX with PVC adapters, Carlon E945 Series, Kraloy OPEJ Series
    - d. Or approved equivalent.

**2.02 RIGID METAL CONDUIT (RMC)**

- A. UL 6, ANSI C80.1. Hot dipped galvanized steel conduit after thread cutting.
1. Fittings: NEMA FB2.10.

**2.03 POLYVINYL CHLORIDE (PVC) EXTERNALLY COATED GALVANIZED RIGID METAL CONDUIT**

- A. Description: UL 6, ANSI C80.1, and NEMA RN 1; rigid steel conduit with external PVC coating.
1. PVC Coating: Minimum 40 mils in thickness.

- B. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.

#### **2.04 ELECTRICAL METALLIC TUBING (EMT)**

- A. Description: UL 797, ANSI C80.3; steel galvanized tubing.
- B. Fittings: NEMA FB 1; steel, compression type.

#### **2.05 FLEXIBLE METAL CONDUIT (FMC)**

- A. Description: UL 1, interlocked steel construction.
- B. Fittings: NEMA FB 2.20.

#### **2.06 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)**

- A. Description: UL 360, inner core made from spiral wound strip of heavy gauge, hot dipped galvanized low carbon steel. 3/4-inch through 1-1/4-inch trade sizes to have a square lock core and contain an integral bonding strip of copper. 1-1/2-inch and larger to have fully interlocked core. Jacket material to be moisture, oil and sunlight resistant flexible PVC.
- B. Fittings: NEMA FB 2.20.

#### **2.07 ELECTRICAL POLYVINYL CHLORIDE (PVC) CONDUIT**

- A. Description: UL 651, NEMA TC 2; Schedule 40 PVC.
- B. Fittings: NEMA TC 3.

#### **2.08 CONDUIT FITTINGS**

- A. Bushings:
  - 1. Insulated type for threaded raceway connectors without factory-installed plastic throat conductor protection.
  - 2. Insulated grounding type for threaded raceway connectors.
- B. Raceway Connectors and Couplings:
  - 1. Steel connectors, couplings, and conduit bodies, hot-dip galvanized.
  - 2. Connector locknuts to be steel, with threads meeting ASTM tolerances. Locknuts to be hot-dip galvanized.
  - 3. Connector throats (EMT, flexible conduit, metal clad cable and cordset connectors) to have factory installed plastic inserts permanently installed. For normal cable or conductor exiting angles from raceway, the cable jacket or conductor insulation to bear only on plastic throat insert.
  - 4. Steel gland, Tomic or Breagle connectors and couplings are recognized for this Contract as having acceptable raceway to fitting electrical conductance.
  - 5. Set screw connectors and couplings, without integral compression glands, are recognized for this Contract as not having acceptable raceway to fitting electrical conductance. A ground conductor sized per this Specification must be included and bonded within raceway assembly utilizing this type connector or coupling.
- C. Provide expansion/deflection fittings for EMT.

### **PART 3 - EXECUTION**

#### **3.01 GENERAL INSTALLATION REQUIREMENTS**

- A. Finished Surfaces: Schedule raceway installation to avoid conflict with installed wall and ceiling surfaces. If unavoidable, coordinate work and repairs with Architect.
- B. Conduit Size:
  - 1. Minimum Size: 3/4-inch for power and control, unless otherwise noted. 3/4-inch for communication/data, unless otherwise noted. 3/4-inch for signal systems, unless otherwise noted.
- C. Underground Installations:

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1. More than 5-feet from Foundation Wall: Use PVC.
  2. Within 5-feet from Foundation Wall: Use PVC.
  3. Minimum Size: 1-inch.
- D. Provide two pull strings/tapes in empty conduits. Types:
1. Feeders: Polyester measure/pulling tape, Greenlee 4436 or approved.
  2. Branch Circuits and Low Voltage: Greenlee Poly Line 431 or approved.
  3. If fish tape is used for pulling line or low voltage wiring, fiberglass type to be used. Metal fish tapes will not be allowed.
  4. Secure pull string/tape at each end.
  5. Provide caps on ends of empty conduit to be used in future.
  6. Label both ends of empty conduits with location of opposite end.
- E. Elbows: Use fiberglass.
- F. Verify that field measurements are as shown on Drawings.
- G. Plan locations of conduit runs in advance of the installation and coordinate with ductwork, plumbing, ceiling and wall construction in the same areas.
- H. Locate penetrations and holes in advance where they are proposed in the structural sections such as footings, beams, and walls. Penetrations are acceptable only when the following occurs:
1. Where shown on the Structural Drawings.
  2. As approved by the Structural Engineer prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
- I. Verify routing and termination locations of conduit prior to rough-in.
- J. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.
- K. Install raceways securely, in neat and workmanlike manner, as specified in NECA 1, Standard Practices for Good Workmanship in Electrical Construction.
- L. Install steel conduit as specified in NECA 101, Standard for Installing Steel Conduits.
- M. Install nonmetallic conduit in accordance with manufacturer's instructions.
- N. Inserts, anchors and sleeves.
1. Coordinate location of inserts and anchor bolts for electrical systems prior to concrete pour.
  2. Coordinate location of sleeves with consideration for other building systems prior to concrete pour.
- O. Conduit Supports:
1. Arrange supports to prevent misalignment during wiring installation.
  2. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
  3. Group related conduits; support using conduit rack. Construct rack using steel channel. Provide space on each for 25 percent additional conduits.
  4. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
  5. Do not attach conduit to ceiling support wires.
- P. Flexible metal conduit length not-to-exceed 6-feet, 3-feet in concealed walls. Provide sufficient slack to reduce the effect of vibration.
- Q. Install conduit seals at boundaries where ambient temperatures differ by 10 degrees F or more as shown on the drawings. Install seals on warm side of partition.
- R. Seal raceways stubbing up into electrical equipment. Plug raceways with conductors with duct-seal. Cap spare raceways and plug PVC raceway products with plastic plugs as made by

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- Underground Products, or equal, shaped to fit snugly into the stubup.
- S. Seal raceways penetrating an exterior building wall to prevent moisture and vermin from entering into the electrical equipment.
  - T. Use suitable caps on spare and empty conduits to protect installed conduit against entrance of dirt and moisture.
  - U. Keep emergency system wiring independent of other wiring systems per NEC 700.
  - V. Arrange conduit to maintain headroom and present neat appearance.
  - W. Do not install conduits on surface of building exterior, along vapor barrier, across roof, on top of parapet walls, or across floors, unless otherwise noted on drawings.
  - X. Exposed conduits are permitted only in following areas:
    - 1. Mechanical rooms, electrical rooms or spaces where walls, ceilings and floors will not be covered with finished material.
    - 2. Existing walls that are concrete or block construction.
    - 3. Where specifically noted on Drawings.
    - 4. Route exposed conduit parallel and perpendicular to walls, tight to finished surfaces and neatly offset into boxes.
  - Y. Do not install conduits or other electrical equipment in obvious passages, doorways, scuttles or crawl spaces which would impede or block area passage's intended usage.
  - Z. Install continuous conduit and raceways for electrical power wiring and signal systems wiring.
    - 1. See Section 26 05 43, Electrical Vaults and Underground Raceways.
    - 2. Use PVC, PVC coated RMC, or fiberglass conduit.
    - 3. Provide watertight conduit sleeves and rubber seals for conduit entering building below grade, Link-Seal system by Thunderline Corporation or approved equivalent.
  - AA. Route conduit installed above accessible ceilings parallel and perpendicular to walls.
  - BB. Maintain adequate clearance between conduit and piping.
  - CC. Keep conduits a minimum of 12-inches away from steam or hot water radiant heating lines (at or above 104 degrees F) or 3-inches away from waste or water lines.
  - DD. Cut conduit square using saw or pipecutter; deburr cut ends.
  - EE. Bring conduit to shoulder of fittings; fasten securely.
  - FF. Use conduit hubs to fasten conduit to cast boxes in damp and wet locations.
  - GG. Install no more than the equivalent of three 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams.
  - HH. Use hydraulic one shot bender to fabricate elbows for bends in metal conduit larger than 2-inch size.
  - II. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
  - JJ. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic, control, and expansion joints.
  - KK. Conduit Terminations for Signal Systems: Provide a plastic bushing on the end of conduit used for signal system wiring.
  - LL. Feeders: Do not combine or change feeder runs.
  - MM. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 07, Thermal and Moisture Protection.
  - NN. Route conduit through roof openings for piping and ductwork wherever possible. Where separate roofing penetration is required, coordinate location and installation method with roofing installation and installer.



**3.02 RIGID METAL CONDUIT (RMC) INSTALLATION**

- A. Outdoor Locations Above Grade: RMC.
- B. Damp Locations: RMC.
- C. In areas exposed to mechanical damage: RMC.
- D. For security conduits installed exposed and subject to tampering: RMC.

**3.03 POLYVINYL CHLORIDE (PVC) EXTERNALLY COATED GALVANIZED RIGID METAL CONDUIT INSTALLATION**

- A. Use PVC coated RMC 36-inch radius ells for power service conduits and 48-inch radius ells for telephone service conduits.

**3.04 ELECTRICAL METALLIC TUBING (EMT) INSTALLATION**

- A. Dry Locations:
  - 1. Concealed: EMT.
  - 2. Exposed: EMT.
- B. Dry, Protected: EMT.

**3.05 FLEXIBLE METAL CONDUIT (FMC) INSTALLATION**

- A. Dry Locations: Motors, recessed luminaires and equipment connections subject to movement or vibration, use flexible metallic conduit.
- B. Install 12-inch minimum slack loop on flexible metallic conduit.

**3.06 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC) INSTALLATION**

- A. Use PVC coated liquidtight flexible metallic conduit for motors and equipment connections subject to movement or vibration and subjected to any of following conditions: Exterior location, moist or humid atmosphere, corrosive environments, water spray, oil, or grease.
- B. Install 12-inch minimum slack loop on liquidtight flexible metallic conduit.

**3.07 ELECTRICAL POLYVINYL CHLORIDE (PVC) CONDUIT INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Provide equipment grounding conductor in PVC conduit runs containing power conductors.
- C. Underground Installation:
  - 1. Areas subject to vehicular traffic: Schedule 80 PVC.
  - 2. Other underground applications: Schedule 40 PVC, except where prohibited by the NEC or local codes.
- D. Convert PVC conduit to Rigid Metal Conduit (RMC) prior to emerging from underground, concrete encasement, or concrete slab.
- E. Provide expansion fittings to compensate for expansion and contraction per NEC 352.44.
- F. PVC elbows are not acceptable. Use fiberglass or PVC coated RMC.
- G. Trim cut ends inside and outside to remove rough edges.
- H. Provide bushings when entering a box, fitting or other enclosure.

**3.08 CONDUIT FITTINGS INSTALLATION**

- A. Conduit Joints: Assemble conduits continuous and secure to boxes, panels, luminaires and equipment with fittings to maintain continuity. Provide watertight joints where embedded in concrete, below grade or in damp locations. Seal metal conduit with metal thread primer. Rigid conduit connections to be threaded, clean and tight (metal to metal). Threadless connections are not permitted for RMC.
- B. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in

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fitting. Allow joint to cure for 20 minutes, minimum.

- C. Use set screw type fittings only in dry locations. When set screw fittings are utilized provide insulated continuous equipment ground conductor in conduit, from overcurrent protection device to outlet.
- D. Use compression fittings in dry locations, damp and rain-exposed locations. Maximum size permitted in damp locations and locations exposed to rain is 2-inches in diameter.
- E. Use threaded type fittings in wet locations, hazardous locations, and damp or rain-exposed locations where conduit size is greater than 2-inches.
- F. Use PVC coated, threaded type fittings in corrosive environments.
- G. Use insulated type bushings with ground provision at switchboards, panelboards, safety disconnect switches, junction boxes that have feeders 60 amperes and greater.
- H. Condulets and Conduit Bodies:
  - 1. Do not use condulets and conduit bodies in conduits for signal wiring, in feeders 100 amp and larger, or for conductor splicing.
- I. Sleeves and Chases - Floor, Ceiling and Wall Penetrations: Provide necessary rigid conduit sleeves, openings and chases where conduits or cables are required to pass through floors, ceilings or walls.
- J. Expansion Joints:
  - 1. Provide conduits crossing expansion joints where cast in concrete with expansion-deflection fittings, installed per manufacturer's recommendations.
  - 2. Secure conduits 3-inches and larger to building structure on opposite sides of a building expansion joint with an expansion-deflection fitting across joint installed per manufacturer's recommendations.
  - 3. Provide conduits less than 3-inches where not cast in concrete with junction boxes securely fastened on both sides of expansion joint, connected together with 15-inches of slack (minimum of 15-inches longer than straight line length) flexible conduit and copper green ground bonding jumper. In lieu of this flexible conduit, an expansion-deflection fitting, as indicated for conduits 3-inch and larger may be installed.
  - 4. Verify expansion/deflection requirements with Structural Engineer prior to installation.
- K. Seismic Joints:
  - 1. No conduits cast in concrete allowed to cross seismic joint.
  - 2. Provide conduits with junction boxes securely fastened on both sides of seismic joint, connected together with 15-inches of slack (minimum of 15-inches longer than straight line length) flexible conduit and copper green ground bonding jumper. Prior to installation, verify with Architect that 15-inches is adequate for designed movement, and if not, increase this length as required.
  - 3. Provide conduits less than 3-inches where not cast in concrete with junction boxes securely fastened on both sides of expansion joint, connected together with 15-inches of slack (minimum of 15-inches longer than straight line length) flexible conduit and copper green ground bonding jumper. In lieu of this flexible conduit, an expansion-deflection fitting, as indicated for conduits 3-inches and larger may be installed.
- L. Provide rigid conduit coupling flush with surface of slab or wall for conduit stubbed in concrete slab or wall to serve electrical equipment or an outlet under table or to supply shop tool, etc. Provide plug where conduit is to be used in future.

**END OF SECTION**

**SECTION 260534  
BOXES**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Outlet Boxes
  - 2. Floor Boxes
  - 3. Pull and Junction Boxes
  - 4. Box Extension Adapter
  - 5. Weatherproof Outlet Boxes
- B. Provide electrical boxes and fittings for a complete installation. Include but not limited to outlet boxes, junction boxes, pull boxes, bushings, locknuts and other necessary components.

**1.02 RELATED SECTIONS**

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
  - 1. Section 26 05 33, Raceways
  - 2. Section 26 05 53, Identification for Electrical Systems

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

- A. Outlet Boxes:
  - 1. Hubbell
  - 2. Thomas & Betts
  - 3. Eaton/Crouse-Hinds
  - 4. Or approved equivalent.
- B. Floor Boxes:
  - 1. Legrand (Wiremold)
  - 2. FSR
  - 3. Hubbell
  - 4. Thomas & Betts
  - 5. MonoSystems
  - 6. Eaton/Crouse-Hinds
  - 7. Or approved equivalent.
- C. Pull and Junction Boxes:
  - 1. Eaton/Crouse-Hinds

2. Hoffman
  3. Or approved equivalent.
- D. Box Extension Adapter:
1. Hubbell
  2. Thomas & Betts
  3. Eaton/Crouse-Hinds
  4. Or approved equivalent.
- E. Weatherproof Outlet Boxes:
1. Legrand (Pass & Seymour)
  2. Hubbell
  3. Thomas & Betts
  4. Eaton/Crouse-Hinds
  5. Intermatic
  6. Or approved equivalent.

## 2.02 OUTLET BOXES

- A. Luminaire Outlet: 4-inch octagonal box, 1-1/2-inches deep with 3/8-inch luminaire stud if required. Provide raised covers on bracket outlets and on ceiling outlets.
- B. Device Outlet: Installation of one or two devices at common location, minimum 4-inches square, minimum 1-1/2-inches deep for non-USB type devices. Installation of one or two devices at common locations, minimum 4-inches square, minimum 2-inches deep for USB type devices. Single- or two-gang flush device raised covers.
- C. Telecom Outlet: Provide 4-inches square, minimum 2-1/8-inch deep box with two-gang plaster ring.
- D. Multiple Devices: Three or more devices at common location. Install one-piece gang boxes with one-piece device cover. Install one device per gang.
- E. Masonry Boxes: Outlets in concrete.
- F. Construction: For interior locations, provide galvanized steel outlet wiring boxes, of the type, shape and size, including depth of box, to suit each respective location and installation; constructed with stamped knockouts in back and sides, and with threaded holes with screws for securing box covers or wiring devices. All surface mounted outlet boxes are to be drawn. Welded boxes are not acceptable.
- G. Accessories: Provide outlet box accessories for each installation, including mounting brackets, wallboard hangers, extension rings, luminaire studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes being used and meeting requirements of individual wiring situations.
- H. Noise Control: Provide acoustic putty pad to back side of each outlet box installed in acoustic rated walls.

## 2.03 FLOOR BOXES

- A. Basis of Design: Floor boxes are based on Legrand/Wiremold as the manufacturer. Manufacturers are approved for use on this project on condition of meeting or exceeding basis of design for conditions of use, box capacity, total allowed connecting conduit capacity, and available finishes. Products ordered or installed not meeting basis of design are subject to removal and replacement at no cost to Owner.
- B. Floor Boxes:
  1. Multi-Gang Box, accepts up to 1.25-inch conduits. Rubber gasket protects interior from water and debris. 4-gang. Provide with 2 duplex receptacle(s) and activations for 2 telecom/AV outlets. Rectangular activation, flanged, for use with matching carpet or tile insert. Finish: aluminum. Legrand/Wiremold, or approved.

#### **2.04 PULL AND JUNCTION BOXES**

- A. Construction: Provide ANSI 61 gray polyester powder painted sheet steel junction and pull boxes, with screw-on covers; of type shape and size, to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.
- B. Location:
  - 1. Provide junction boxes above accessible ceilings for drops into walls for receptacle outlets from overhead.
  - 2. Provide junction boxes and pull boxes to facilitate installation of conductors and limiting accumulated angular sum of bends between boxes, cabinets and appliances to 270 degrees.

#### **2.05 BOX EXTENSION ADAPTER**

- A. Construction: Diecast aluminum.
- B. Location: Install over flush wall outlet boxes to permit flexible raceway extension from flush outlet to fixed or movable equipment.

#### **2.06 WEATHERPROOF OUTLET BOXES**

- A. Construction: Provide corrosion-resistant cast metal weatherproof outlet wiring boxes, of the type, shape and size, including depth of box, with threaded conduit ends, cast metal faceplate with spring-hinged waterproof cap suitably configured for each application, including faceplate, gasket, blank plugs and corrosion proof fasteners. Weatherproof boxes to be constructed to have smooth sides, gray finish.

### **PART 3 - EXECUTION**

#### **3.01 GENERAL INSTALLATION REQUIREMENTS**

- A. Coordinate locations of floor boxes and wall mounted wiring device boxes with architectural and structural floor plans prior to rough-in.
- B. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1, Standard Practice of Good Workmanship in Electrical Construction.
- C. Secure boxes rigidly to substrate upon which they are being mounted, or solidly embed boxes in concrete or masonry.
- D. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NEC. Locate boxes and conduit bodies so as to ensure accessibility of electrical wiring.
- E. Set wall mounted boxes at elevations to accommodate mounting heights shown on Architectural Elevations.
- F. Electrical boxes are shown on drawings in approximate locations unless dimensioned.
  - 1. Adjust box locations up to 10-feet if required to accommodate intended purpose.
- G. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 07, Thermal and Moisture Protection.
- H. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- I. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12-inches of box.
- J. Box Color Coding and Marking: Reference Section 26 05 53, Identification for Electrical Systems.
- K. Adjust boxes to be parallel with building lines. Boxes not plumb to building lines are not acceptable.
- L. Install knockout closures in unused box openings.

- M. Clean interior of boxes to remove dust, debris, and other material.
- N. Clean exposed surfaces and restore finish.

### **3.02 OUTLET BOXES INSTALLATION**

- A. Mount outlet boxes, unless otherwise required by ADA, or noted on drawings, following distances above finished floor:
  - 1. Control Switches:
    - a. 48-inches to the top of outlet box.
    - b. 4-inches above top of backsplash at countertops/workstations, not-to-exceed 44-inches above finished floor to the top of outlet box per ADA requirements.
  - 2. Receptacles: 15-inches to the bottom of outlet box.
  - 3. Telecom Outlets: 15-inches to the bottom of outlet box.
  - 4. Other Outlets: As indicated in other sections of specifications or as detailed on drawings.
- B. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6-inches from ceiling access panel or from removable recessed luminaire.
- C. Flush Outlets in Insulated Spaces: Maintain integrity of insulation and vapor barrier.
- D. Coordinate electrical device locations and elevations (switches and receptacles) with architectural drawings to prevent mounting devices in mirrors, back splashes, and behind cabinets.
- E. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
- F. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices. Adjacent boxes not aligned vertically to be adjusted at no additional cost to Owner.
- G. Use flush mounting outlet box in finished areas.
- H. Do not install flush mounting box back-to-back in walls; provide minimum 6-inches separation. Provide minimum 24-inches in acoustic rated walls.
- I. In acoustical walls, apply acoustic putty pad on outlet box prior to installation of acoustical blanket.
- J. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- K. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- L. Use adjustable steel channel fasteners for hung ceiling outlet box.
- M. Use gang box where more than one device is mounted together. Do not use sectional box.
- N. Use gang box with plaster ring for single device outlets.
- O. Adjust flush-mounting outlets to make front flush with finished wall material.

### **3.03 FLOOR BOXES INSTALLATION**

- A. Set floor boxes level.
- B. Adjust floor boxes flush with finish flooring material.

### **3.04 PULL AND JUNCTION BOXES INSTALLATION**

- A. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- B. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6-inches from ceiling access panel or from removable recessed luminaire.
- C. Do not fasten boxes to ceiling support wires.
- D. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

**3.05 BOX EXTENSION ADAPTER INSTALLATION**

- A. Match material to box.
- B. Install gaskets at exterior and wet locations.

**3.06 WEATHERPROOF OUTLET BOXES INSTALLATION**

- A. Use cast outlet box in exterior locations exposed to weather and wet locations.
- B. Install gaskets.

**END OF SECTION**

**SECTION 260553**  
**IDENTIFICATION FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Equipment Nameplates
  - 2. Wire Markers

**1.02 RELATED SECTIONS**

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**1.04 SUBMITTALS**

- A. Submittals not required for this Section.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Manufacturer's Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required.
  - 2. Manufacturer's standard products of categories and types required for each application as referenced in other Division 26, Electrical Sections. Where more than a single type is specified for application, provide single selection for each product category.
  - 3. Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices unless otherwise indicated.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

- A. Equipment Nameplates:
  - 1. B & I Nameplates
  - 2. Intellicum
  - 3. JBR Associates
  - 4. Or approved equivalent.
- B. Wire Markers:
  - 1. Brady
  - 2. Panduit
  - 3. Sumitomo
  - 4. Or approved equivalent.

**2.02 EQUIPMENT NAMEPLATES**

- A. Engraved phenolic plastic, laminate, minimum 1/16-inch thick in the size indicated, with beveled edge border matching letter color. Federal specification LP-387A. All upper case letters in engraver standard letter style of the size and wording indicated. Provide with 2-mil adhesive backing. Embossed tape style labels are not acceptable.
- B. Color:



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1. Normal (Utility): White letters on black background.
- C. Letter Size:
  1. Use 1/2-inch letters minimum for identifying major equipment and loads, including switchgear, switchboards, distribution panels, generators, automatic transfer switches, UPS, etc.
  2. Use 1/4-inch or 1/2-inch letters minimum for identifying panels, breakers, transformers, VFDs, disconnects, etc.
  3. Use 3/16-inch minimum for identifying source, voltage, current, phase, wire configurations, and short circuit current rating (SCCR).
- D. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
- E. The Architect, Engineer, Commissioning Agent and Owner reserve the right to make modifications to the nameplates as necessary.
- F. Locations:
  1. Switchgear, switchboards.
  2. Main breakers and distribution breakers in switchgear, switchboards, and distribution panels.

### **2.03 WIRE MARKERS**

- A. Description: Vinyl-cloth self-adhesive type wire markers.
- B. Locations: Each conductor at panelboard gutters, pull boxes, outlet boxes, junction boxes, and each load connection.
- C. Power and Lighting Circuits: Branch circuit or feeder number as indicated on drawings and source panel.
- D. Control Circuits: control wire number indicated on schematic and interconnection diagrams on drawings or shop drawings.

## **PART 3 - EXECUTION**

### **3.01 GENERAL INSTALLATION REQUIREMENTS**

- A. Coordinate designations used on Drawings with equipment nameplates and device labels.
- B. Install nameplates and labels parallel to equipment lines.
- C. Identify empty conduit and boxes with intended use.
- D. Provide typewritten branch panel schedules with protective clear transparent covers accounting for every breaker installed. Use actual room designations assigned by name or number near completion of the work, and not the designations shown on drawings.
- E. Provide color coded boxes as follows:
  1. Fire Alarm: Red.

### **3.02 EQUIPMENT NAMEPLATES**

- A. Degrease and clean surfaces to receive nameplates.
- B. Secure equipment nameplates to equipment front using manufacturer adhesive backing.
- C. Secure equipment nameplates to inside surface of door on panelboard that is recessed in finished locations.
- D. Verify emergency system distribution equipment nameplate colors with Architect/Owner.
- E. Switchgear, switchboards, sub-distribution switchboards, distribution panels and branch panels to include name, source, voltage, current, phase, wire configuration, and short circuit current rating (SCCR). Transformers to include source, KVA, and secondary voltage, phase, and wire configuration.

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- F. Provide nameplates for flush mounted branch panelboards identifying name on front door. On inside of door provide nameplate as noted above. Verify with Architect/Owner if nameplate on outside of door is required.
- G. Provide a second label at branch panelboards listing the means of identification of branch circuit conductors. This identification legend to consist of the color code used for each voltage system (208Y/120V and 480Y/277V). Include identification of both voltage systems on each label, regardless of the voltage of the panelboard to which the label is affixed. Comply with requirements of NEC 210.5.
  - 1. See Specification Section 26 05 19, Low-Voltage Electrical Power Conductors and Cables, for required conductor color code for this project.

**3.03 WIRE MARKERS**

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Provide wire markers on each conductor for power, control, signalling and communications circuits.

**END OF SECTION**

**SECTION 260573  
ELECTRICAL DISTRIBUTION SYSTEM STUDIES**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Protective Devices
  - 2. Short Circuit Study
  - 3. Arc Flash Labels
  - 4. Arc Flash Risk Assessment

**1.02 RELATED SECTIONS**

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
  - 1. Section 26 24 16, Panelboards
  - 2. Section 26 28 00, Overcurrent Protective Devices
  - 3. Section 26 28 16, Enclosed Switches and Circuit Breakers

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. IEEE 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
  - 2. IEEE 399, Recommended Practice for Industrial and Commercial Power Systems Analysis.
  - 3. IEEE 1584, Guide for Performing Arc Flash Calculation.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition provide:
  - 1. Power system studies required under this Section with submittals for electrical equipment, including overcurrent protective devices.
  - 2. Electrical equipment ordered prior to submittal of power system studies are not compliant with these specifications, and are subject to removal and replacement at no cost to Owner where not in compliance with Code and Contract Documents for selective coordination.
    - a. Provide written verification with Stamp or Seal and signature of preparing Engineer.
  - 3. Provide samples of NFPA 70E compliant arc flash hazard labeling for electrical equipment.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Study Preparer Qualifications: Qualified engineer of switchgear manufacturer or approved professional engineer.
    - a. Experienced in preparation of studies of similar type and magnitude.
    - b. Familiar with software analysis products specified.
  - 2. Computer Software for Study Preparation: Use latest edition of commercially available software utilizing specified methodologies.
    - a. Acceptable Software Products:

- 1) EasyPower
  - 2) Operation Technology, Inc; ETAP.
  - 3) SKM Systems Analysis, Inc; Power Tools for Windows.
- b. The above manufacturers are known to be acceptable for study purposes. At the completion of the study, provide an electronic EasyPower file of the project to the Owner/Engineer. The file is to include all files required to edit and evaluate the electronic model, including libraries, one-lines, scenarios, TCC curves and all reports.
3. Contractor Responsibility: Provide project-related data needed by study preparer, including equipment, wire sizes, insulation types, conduit types, actual circuit lengths and available fault currents from utility. Provide information in a timely matter to allow studies to be completed prior to release of equipment.

#### **1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

### **PART 2 - PRODUCTS**

#### **2.01 GENERAL**

- A. Analyze specific electrical and utilization equipment (according to NEC definition), actual protective devices to be used, and actual feeder lengths to be installed.
1. Scope of Studies: New distribution wiring and equipment, from primary source to buses and branch circuit panelboards and equipment rated 50A or larger at utilization voltage.
  2. Primary Source, for Purposes of Studies: Utility company transformer secondary.
  3. Study Methodology: Comply with requirements and recommendations of NFPA 70, IEEE 399, and IEEE 242.
  4. Report: State methodology and rationale employed in making each type of calculation; identify computer software package(s) used.
- B. One-Line Diagrams: Prepare schematic drawing of electrical distribution system, with electrical equipment and wiring to be protected by protective devices; identify nodes on diagrams for reference on report that includes:
1. Calculated fault impedance, X/R ratios, utility contribution, and short circuit values (asymmetric and symmetric) at main switchboard bus and downstream devices containing protective devices.
  2. Breaker and fuse ratings.
  3. Transformer kVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.
  4. Identification of each bus, with voltage.
  5. Conduit materials, feeder sizes, actual lengths, and X/R ratios.

#### **2.02 PROTECTIVE DEVICES**

- A. Provide protective devices of ratings and settings as required so that protective device closest to fault will open first.
- B. Replace existing protective devices to achieve specified performance.
- C. Analyze and determine ratings and settings of protective devices to minimize damage caused by fault and so that protective device closest to fault will open first.
1. Required Ratings and Settings: Derive required ratings and settings of protective devices in consideration of upstream protective device settings and optimize system to ensure selective coordination.
  2. Motors with Solid-State Protective Modules: Select settings for best possible motor protection, taking into consideration actual installed motor torque and current and thermal characteristics.
  3. Identify any equipment, both new and existing, that is underrated.

4. Identify specified protective devices that will not achieve required protection or coordination but with minor changes can be made to do so; provide such modified devices at no additional cost to Owner and identify them on submittals as "revised in accordance with Protective Device Coordination Study"; minor changes include different trip sizes in same frame, time curve characteristics of induction relays, CT ranges, etc.
  5. Identify specified protective devices that will not achieve required protection or coordination and cannot be field adjusted to do so, and for which adequate devices would involve change to contract sum.
  6. In all cases where adequate protection or coordination cannot be achieved at no extra cost to Owner, provide a discussion of alternatives and logical compromises for best achievable coordination.
  7. Do not order, furnish, or install protective devices that do not meet performance requirements unless specifically approved by Engineer.
- D. Protective Device Rating and Setting Chart: Summarize in tabular format required characteristics for each protective device based on analysis; include:
1. Device identification.
  2. Relay CT ratios, tap, time dial, and instantaneous pickup.
  3. Circuit breaker sensor rating, long-time, short-time, and instantaneous settings, and time bands.
  4. Fuse rating and type.
  5. Ground fault pickup and time delay.
  6. Input level and expected response time at two test points that are compatible with commonly available test equipment and ratings of protective device.
  7. Highlight devices that as furnished by Contractor will not achieve required protection.
- E. Specified equipment has been designed and selected to achieve specified performance; ensure that equipment actually installed provides that performance.
- F. In addition to requirements specified elsewhere, provide overcurrent protective devices having ratings and settings in accordance with results of system studies.

### **2.03 SHORT CIRCUIT STUDY**

- A. Calculate fault impedance to determine available 3-phase short circuit and ground fault currents at each bus and piece of equipment during normal conditions, alternate operations, emergency power conditions, and other operations that could result in maximum fault conditions.
1. Show fault currents available at key points in system down to fault current of 1,000 A at 208 V.
  2. Include motor contributions in determining momentary and interrupting ratings of protective devices.
  3. Primary Fault Level Assumptions: Obtain data from utility company.

### **2.04 ARC FLASH LABELS**

- A. Provide label compliant with NFPA 70E guidelines indicating personal protective equipment (PPE) recommended for servicing of electrical equipment while energized, as well as calculated incident energy levels and arc flash protective boundary distance.

### **2.05 ARC FLASH RISK ASSESSMENT**

- A. Calculate arc flash incident energy (AFIE) levels and flash protection boundary distances to determine required level of personal protective equipment (PPE) at each bus and piece of equipment during normal conditions, emergency power conditions, and other operations that could result in maximum arc flash incident energy levels.
1. Show flash protection boundary distance.
  2. Include incident energy levels.

### **PART 3 - EXECUTION**

#### **3.01 FIELD QUALITY CONTROL**

- A. Provide services of qualified field engineer and necessary tools and equipment to test, calibrate, and adjust installed protective devices to conform to requirements determined by coordination analysis.
- B. Adjust installed protective devices having adjustable settings to conform to requirements determined by coordination analysis.
- C. Submit report showing final adjusted settings of protective devices.

#### **3.02 ELECTRICAL POWER SYSTEM STUDIES**

- A. Short Circuit Analysis Study:
  - 1. Provide complete short circuit study, equipment interrupting and withstand evaluation. Study to include complete electrical distribution system, including contributions from normal source of power without alternative sources of power. Include complete low voltage distribution systems as specified in this Section.
  - 2. Study Basis: thoroughly cover normal and alternative operation modes that can produce maximum fault conditions, including simultaneous motor contributions.
  - 3. Perform study in accordance with applicable ANSI/IEEE Standards.
  - 4. Study Input Data: Utility company short circuit single and three phase contribution, and X/R ratio; resistance and reactance components of each feeder, busway and branch impedance; motor and generator contributions; applicable circuit parameters and contribute to short circuit duty.
  - 5. Calculate short circuit momentary duties and interrupting duties on basis of maximum available fault current at each switchgear bus, switchboard, motor control center, panelboards, transfer switches, busway plug connection point, dry-type transformer primary and secondary locations, other significant locations throughout system affected by available fault current (including large HVAC units, uninterruptible power supplies, etc.).
  - 6. Perform equipment evaluation study to determine adequacy of overcurrent protection devices by tabulating and comparing short circuit ratings of these devices with available fault current. Notify Owner in writing where problem areas or inadequacies appear in electrical equipment.
  - 7. Study Report: In bound final report, include sheets listing tabulated information from study, including feeder impedances, motor, utility and generator impedances and fault contributions, and resulting short circuit current including asymmetrical, symmetrical, three, five and eight cycle fault current levels, and line-to-neutral and three-phase-bolted-fault current levels at each calculated point in electrical distribution system.
- B. Arc Flash Risk Assessment:
  - 1. Perform arc flash risk assessment with aid of computer software intended for this purpose.
  - 2. Perform arc flash risk assessment in conjunction with short-circuit analysis and time-current coordination analysis.
  - 3. Submit results of assessment in tabular form, and include device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, personal-protective equipment classes and AFIE levels.
  - 4. Perform analysis under worst-case arc flash conditions, and final report describes, when applicable, how these conditions differ from worst-case bolted fault conditions.
  - 5. Arc flash risk assessment includes recommendations for reducing AFIE levels and enhancing worker safety.
  - 6. Proposed vendor demonstrates experience with arc flash risk assessment by submitting names of at least ten actual arc flash risk assessments it has performed in past year.
  - 7. Proposed vendor demonstrates capabilities in providing equipment, services, and training to reduce arc flash exposure and train workers in accordance with NFPA 70E and other applicable standards.

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8. Proposed vendor demonstrates experience in providing equipment labels in compliance with OESC and ANSI Z535.4 to identify AFIE and appropriate Personal Protective Equipment classes.

**END OF SECTION**

**SECTION 260800  
COMMISSIONING OF ELECTRICAL**

**SUMMARY**

**1.01 SECTION INCLUDES**

- A. Commissioning activities required for work of Division 26 Sections including but not limited to construction checks, equipment start-up, functional testing, and operator training.
- B. Comply with Section 01 91 13 – General Commissioning Requirements for Commissioning activities for Division 26 work.

**1.02 SEQUENCING**

- A. Provide written notification to Commissioning Provider (CxP) in advance of significant project dates including but not limited to the following:
  - 1. Two weeks prior to Manufacturer's start-up of lighting control system.

**1.03 SUBMITTALS**

- A. Provide submittals of systems being commissioned to Owner's Authorized Representative as required by Section 01 91 13.

**PART 2 - PRODUCTS**

**2.01 NOT USED**

**PART 3 - EXECUTION**

**3.01 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Services: Manufacturer's representative to perform construction checks and operational training as specified in Division 26 including the following systems:
  - 1. Lighting Control System

**3.02 CONSTRUCTION CHECKLISTS**

- A. Contractor shall perform as required by Section 01 91 13. Construction checklists for each system being commissioned will be prepared by Commissioning Provider during construction.
  - 1. Perform voltage and amperage measurements for mechanical equipment as required in Section 22 08 00 and 23 08 00.

**3.03 LIGHTING CONTROL VERIFICATION REPORT**

- A. Control Contractor shall perform construction checks, start-up, and verification of automatic lighting control system. Provide verification report demonstrating proper system installation and operation. Verification shall include the following:
  - 1. Equipment Startup: All equipment being controlled shall be initially started and tested as required by the manufacturer. All required manufacturer installation and start-up checklists shall be attached to the construction checklists.
  - 2. Communication Network Startup: Verify that all lighting control panels properly communicate on network. Verify communication speed and reliability is acceptable.
  - 3. Software Verification: All programs and software functions shall be verified for proper sequence of operation.
  - 4. Controls Verification Report: After system operation is completely verified, provide written certification to Owner that systems have been fully tested and are operating according to specifications and ready for functional testing. Include report to the CxP detailing verification results and the dates, times and person(s) performing startup. Report shall include:
    - 5. Device Calibration Log.
      - a. Lighting Relay Control Panels.
        - 1) Provide date, time, panel designation, and panel location.



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- 2) Provide a list of all programmed time schedules.
- 3) Provide a list of all sweep times, sweep control on or off, and relays that are swept off.
- 4) Provide a list of all group load assignments.
- 5) Provide all photocell control parameters and setpoints.
- 6) Provide a checkout document indicating the following:
  - (a) Lighting relay panel designation.
  - (b) Relay number.
  - (c) Relay description.
  - (d) Power circuit feeding relay.
  - (e) Verified relay operation.
  - (f) Verified time schedule control.
  - (g) Verified sweep control.
  - (h) Verified photocell control
- b. Low Voltage Switches
  - 1) Provide a verification document indicating the following:
    - (a) Switch location.
    - (b) Verified switch operation.
    - (c) Verified switch override operation.
    - (d) Occupancy Sensors
- c. Provide a verification document indicating the following:
  - 1) Room or space designation.
  - 2) Manufacturer.
  - 3) Model.
  - 4) Technology type.
  - 5) DIP settings.
  - 6) Trigger settings.
  - 7) Time delay settings.
  - 8) Sensitivity settings.
  - 9) Verified sensor operation.
  - 10) Daylight Compensation Systems
- d. Provide a verification report indicating the following:
- e. Provide date and time.
  - 1) Room or space designation.
  - 2) Manufacturer.
  - 3) Model.
  - 4) Light level maintained at the work plane.
  - 5) Average light level with all electric lights off and no window obstruction.
  - 6) Average light level with electric lights on and no window obstruction.
  - 7) Average light level with electric lights on and at minimum output with no window obstruction.
  - 8) Average light level with electric lights on and at maximum output with no window obstruction.
  - 9) Average light level with electric lights on at maximum output at night or with windows obstructed.
  - 10) Average light level with electric lights on at minimum output at night or with windows obstructed.
  - 11) Provide all parameters and settings for all devices.
  - 12) Digitally Addressable Lighting Interface Systems
- f. Calibration Log

- 1) Provide date, time control system readout, means of verification, verification measurement, and calibration parameters for each analog input.
- g. Point Summary Log
  - 1) Attach printed log showing detailed descriptive data and configuration parameters for all points.
  - 2) Operational Trend Logs: Include trend logs as follows:
    - (a) Trend data for all analog and digital points.
    - (b) Analog Control: Points that modulate over time shall be sampled at appropriate intervals and durations to demonstrate properly operating sequences. Provide one sample every 5 minutes for at least one week.
    - (c) Digital Control: Dual-state control or monitoring points shall be recorded as COV (change of value). A minimum of one week of samples shall be provided to properly demonstrate equipment cycles, modes, and schedules.
- B. Demonstration: Demonstrate operation of control system to Engineer, CxP, and Owner including:
  1. Menu functions.
  2. Relay overrides.
  3. Programming of relays, time schedules.

### **3.04 FUNCTIONAL TESTING**

- A. Contractor shall perform testing as directed by Commissioning Provider and as required by Section 01 91 13. Functional Test Plans for each system being commissioned will be prepared by Commissioning Provider during construction. Provide an allowance of on-site labor hours per trade for assisting Commissioning Provider with Functional Testing as listed below. Labor required for retesting due to failure of equipment or systems to perform in accordance with Contract Documents shall be provided at no additional cost to Owner.

### **3.05 OPERATIONS AND MAINTENANCE TRAINING**

- A. The Contractor shall provide operation and maintenance instruction to Owner's personnel as required by Division 01 and 26.

### **3.06 SCHEDULE OF SYSTEMS BEING COMMISSIONED**

- A. Commission systems and equipment listed below including associated equipment and control systems.
  1. Automatic Lighting Control System

**END OF SECTION**

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**SECTION 260900**  
**CONTACTORS AND CONTROL DEVICES**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Contactors
  - 2. Electronic Time Switches
  - 3. Photoelectric Switches
  - 4. Emergency Lighting Relays

**1.02 RELATED SECTIONS**

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. UL 924: Standard for Safety of Emergency Lighting and Power Equipment.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Shop Drawings: Submit to NEMA ICS 1 indicating control panel layouts, wiring connections and diagrams, dimensions, support points.
  - 2. Product Data: Provide for each component showing electrical characteristics and connection requirements.
  - 3. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements apply to this Section.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as outlined in Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

- A. Contactors:
  - 1. Asco
  - 2. Eaton Electrical
  - 3. ABB/General Electric
  - 4. Schneider Electric/Square D
  - 5. Siemens
  - 6. Or approved equivalent.
- B. Electronic Time Switches:
  - 1. Intermatic
  - 2. Paragon
  - 3. Sangamo

4. Tork
  5. Or approved equivalent.
- C. Photoelectric Switches:
1. Precision
  2. Paragon
  3. Tork
  4. Or approved equivalent.
- D. Emergency Lighting Relay:
1. Nine 24
  2. Bodine
  3. Wattstopper
  4. Or approved equivalent.

## 2.02 CONTACTORS

- A. Lighting:
1. Continuously rated 20 amp per pole for types of ballast and tungsten lighting and resistance loads, do not derate for use on high-inrush loads.
  2. Power Contacts:
    - a. Double break, silver cadmium oxide.
    - b. Auxiliary arcing contacts not acceptable.
    - c. Convertible Contacts, N.O. or N.C.
    - d. Contact status, N.O. or N.C., clearly visible.
  3. Approved per UL 508.
  4. Design in accordance with NEMA ICS2-211B, rated for application to 600 volt maximum.
  5. Electrically Operated and Mechanically Held Contactor: Encapsulated latch and unlatch coils, coil clearing contacts.
- B. Enclosures: NEMA enclosure suitable for location and use, flush or surface mount as indicated on Drawings.

## 2.03 ELECTRONIC TIME SWITCHES

- A. Digital time clock: Double pole, single throw. One N.O. and one N.C. contact. 7 days operation mode. Astronomical time clock. Holiday schedule. Battery power source to provide minimum three years memory backup. Eight event setpoints. Enclosure with hinged door.

## 2.04 PHOTOELECTRIC SWITCHES

- A. Characteristics:
1. Hermetically sealed light sensitive element installed in die cast weatherproof enclosure.
  2. Adjustable external light level slide.
  3. Swivel adjustable enclosure.
- B. Electrical Rating: 120VAC, 1800VA, connected for pilot duty unless otherwise indicated.

## 2.05 EMERGENCY LIGHTING RELAY

- A. UL924 listed for connected load of 20 amps at 277 volt or 120 volt.
- B. UL rated N.C. contacts, minimum 20 amps rating.
- C. Integral surge protection.
- D. Two separate status emergency lighting indicators for troubleshooting:
1. Amber LED indicates presence of normal utility power.
  2. Red LED indicates presence of unswitched emergency power.
- E. Manual and/or automatic diagnostic testing feature.
- F. Dimming control: Where 0-10 volt dimming control is connected to emergency lighting, supply and connect auxiliary relay to open dimming 0-10 volt control circuit upon loss of normal power,

or else supply emergency lighting relay with integral contact to open 0-10 volt control circuit.

### **PART 3 - EXECUTION**

#### **3.01 GENERAL INSTALLATION REQUIREMENTS**

- A. Testing:
  - 1. Test to ensure that control devices, components, equipment and systems are calibrated, adjusted and operate in accordance with approved drawings and specifications.
    - a. Daylight sensing automatic lighting controls.
    - b. Occupant sensing automatic lighting controls.
    - c. Automatic time switches for lighting control.
    - d. Emergency lighting controls.
  - 2. Functionally test all control devices to ensure operation in accordance with approved drawings and specifications.
  - 3. Prepare and complete report of test procedures and results and file with the Owner.
- B. Install items per manufacturers written instructions.

#### **3.02 CONTACTORS**

- A. Provide vibration isolation mounting pads for electrically held contactors installed within or on walls which are common to occupied spaces. Isolate terminals and operating mechanisms from enclosure.
- B. Install contactors and relays to reduce noise such that it will not create a disturbance or distraction in the areas in which such equipment is located.

#### **3.03 ELECTRONIC TIME SWITCHES**

- A. Install time switches and other automatic control devices in accessible locations near the source of power or grouped at a common location in mechanical rooms or similar spaces.

#### **3.04 PHOTOELECTRIC SWITCHES**

- A. Install photoelectric control devices at such locations as necessary to be most effective. Avoid locating photoelectric devices in or at locations where they can be influenced by other than natural light or under eaves. Verify location of equipment with Architect.
- B. Exterior Lighting Control: Control exterior lighting and interior atrium lighting using photoelectric switches to energize contactors controlling lighting circuits. Time clocks used to deenergize lighting at any preset time if desired.

#### **3.05 EMERGENCY LIGHTING RELAYS**

- A. Emergency Relay (UL924):
  - 1. Provide unswitched emergency circuit, and unswitched and switched normal circuit to UL924 relay for control of emergency luminaires with remaining room luminaires on normal power.
  - 2. Install each relay within dedicated 4-11/16-inch junction box with double-gang plaster ring for wall or ceiling flush-mount as indicated on Drawings. Where location in ceiling would interfere with removal of ceiling tiles, install relay flush-mounted in nearest wall at ceiling level. Do not locate behind wall switch.
  - 3. Where 0-10 volt dimming control is connected to emergency lighting, supply and connect auxiliary relay to open dimming 0-10 volt control circuit upon loss of normal power.

**END OF SECTION**

**SECTION 260920  
LIGHTING RELAY CONTROL PANEL**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Materials and Components
  - 2. Hardware Features
- B. Extent of lighting control system work is indicated by drawings, and by the requirements of this Section. It is defined to include lighting relay control panels, switch inputs, energy management system for HVAC and wiring.
- C. Requirements are indicated elsewhere in these specifications for work including, but not limited to, raceways and electrical boxes and fittings required for installation of control equipment and wiring.
- D. Basis-of-Design: Relay panel layout on Drawings are designed based on the Greengate product line. Approved manufacturers listed are allowed on condition of meeting the specified conditions including connectivity with building control systems (fire alarm, security, BAS), fail-safe operation of emergency lighting in compliance with UL 924, and separation of normal and life safety circuits. Provide additional relay enclosures and communications accessories as needed to provide the same level of functionality as shown on Drawings and required in specifications. Remove and replace electrical equipment not meeting these conditions at no cost to Owner.

**1.02 RELATED SECTIONS**

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Product Data: Submit manufacturer's data on lighting control system and components, including recommended spare parts list.
  - 2. Shop Drawings: Submit drawings of lighting control panel and accessories including, but not necessarily limited to the riser diagram / system diagram, low voltage relay panels, power and communications wiring and termination, input/output schedules and sequence of operation for each control zone.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Test the control panels and list under the UL 916 Energy Management Equipment standards.
  - 2. Oregon Energy Efficiency Specialty Code (OEESC) Compliance.
  - 3. Comply with applicable OESC requirements regarding electrical wiring standards.
  - 4. NEMA Compliance: Comply with applicable portions of the NEMA standards regarding the types of electrical equipment enclosures.
  - 5. Component Pretesting: Control equipment to undergo strict inspection standards. Previously test the equipment and burn-in at the factory prior to installation.

## **1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Provide a 3-year warranty on hardware and software. Systems that provide special warranties based on installation are not acceptable.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Greengate Lighting Control Panels Litekeeper 8
- B. Leviton Lighting Controls
- C. WattStopper
- D. Intelligent Lighting Controls
- E. Lighting Control and Design
- F. Hubbell Control Solutions
- G. Or approved equivalent.

### **2.02 MATERIALS AND COMPONENTS**

- A. System Description:
  - 1. The lighting control system consists of low voltage relay control panels with 64 programmable switch inputs and up to 8 relays.
  - 2. Each low voltage lighting control panel is microprocessor controlled. Accomplish programming through either the RS-232 port or through the network connection or with an integral 2 x 16 - 32 character self-prompting LCD display and programming keypad.
  - 3. Programmable intelligence includes time-of-day control, 32 holiday dates, a Warn Off to warn occupants of an impending off, timed inputs, preset control, auto daylight savings, astronomical clock w/offsets, and local control, digital switches and network overrides.
  - 4. When control panel provides a Warn Off (flash the lights) to inform the occupants of an impending off command, the Warn Off command will allow 10 extra minutes for the occupants to override their lights or exit the premises.
  - 5. Control panels permits lighting to be overridden ON for after-hours use or cleaning. Provide these overrides with hard-wired inputs or voice-guided touch-tone telephone control.
  - 6. Control panel enclosures offer a maximum space of 8 relays.
- B. Basis of Design: Lighting relay panels on Drawings are designed based on Greengate Lighting Control Panels Litekeeper product line. Approved manufacturers listed below are allowed on condition of meeting the specified conditions including the available space for the equipment (including Code required working clearances). Remove and replace electrical equipment installed not meeting these conditions at no cost to Owner.

### **2.03 HARDWARE FEATURES**

- A. Diagnostic Aids:
  - 1. Each control panel to incorporate diagnostic aids for confirmation of proper operation, or in case of failure these aids to guide the individual in rapid troubleshooting of the system.
  - 2. The control panels to employ both a backlit LCD and LED's to indicate:
    - a. POWER (LED)
    - b. SYSTEM OK (LED)
    - c. ON/OFF STATUS of EACH RELAY (LED & LCD)
    - d. SYSTEM CLOCK AND DATE (LCD)
    - e. PROGRAMMING CONFIRMATION (LCD)



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3. Control systems that do not provide visual self-help diagnostics are not acceptable.
- B. Status Indication of Relays: System will provide visible status indication of relays through the window of each control panel. Visual indication to disclose ON/OFF status and relay number. Systems that do not provide relay status while the enclosure door is closed are not acceptable.
- C. Operator Interface: The control panel programming interface resides in firmware in the control panel. The programming interface to consist of a circuit board mounted keypad and 2 line x 16 character LCD display. The integral keypad to provide access to the main programming features. Keypad to permit user to manually command any or all relays individually. Keypad to also allow user to link switch inputs and time schedules to relay outputs. Each panel to control its own loads from internal memory. A control system that relies on a central control computer/processor or external time clocks is not permitted. Systems that utilize blocking diode technology for relay assignments are not acceptable.
- D. Overrides: Controller to provide timers for each override. Provide each override timer capable of 0-999 minutes. Software to enable or disable overrides based on Priorities, Masks or Time of Day scheduling.
- E. Digital Switch: Lighting controller to support digitally addressable LED annunciated switches. Maximum total number of digital switches that may exist on the lighting control network is 16,320. Each Subnet to support 64 buttons. The digital switch network requires CAT 5 cable between switches. Digital switches to control any relay group combination on the Greengate Lighting Control Panels network. Provide data communications status feedback for system checkout and troubleshooting (transmit and receive LED'S) visible on the interface.
  1. Digital switch configuration system to permit custom labeling for multiple button switch locations. Provide Decora® form and function Digital switch configuration.
- F. Dry Contact Inputs: Control system to permit 8 dry contact inputs for override purposes. Support momentary 3 wire or 2 wire (toggle) inputs. Support maintained contacts as 2 wire (SPST) inputs. Provide dry contact Inputs (24VDC at 12 ma. internally supplied to the inputs). 24VDC power supply is provided with an auto-resettable fuse. Should an inappropriate electrical connection be made, design to protect the board and switches until the fault is removed. Software link switch input to any number of relays for override control. Control panel to have dry contact inputs on the logic board. Control systems that utilize separate accessories to allow for dry contact switches are not acceptable. Control systems that do not supply both digital switches and analog switches from the same controller are not permitted.
- G. Photocell Control: Controller to accept dry contact ambient light sensors. Controller to provide power for the sensor thereby eliminating any external power supply. Sensors to provide for outdoor and indoor applications and issue a command to the controller once the threshold is reached. Sensor to provide user adjustable dead band control.
- H. Remote Overrides: Controller to accept remote commands issued from other inputs. Controller to provide this feature without the need to add extra equipment to the controller. Remote overrides can be issued from the Telephone Interface Module (TIM), Photocells, Motion Sensors, Digital or Dry Contact Switches. Lighting systems that need to add extra equipment to receive remote overrides are not acceptable.
- I. Service Override and Priority Override: Control panel to provide a three position master-service override for the control unit. Provide service override that is not accessible from the exterior. Systems that provide a service override on the exterior of the controller are not acceptable.
- J. Modular Design:
  1. Control system to employ modular connectors to avoid repeat wiring in case of component failure. Mount the system CPU board on quick-release spring pins that permit an entire change out of the processor and input board.
  2. Connections for the switch inputs to incorporate modular connectors. Provide modular relay board designed for rapid field replacement or upgrading. Systems that do not employ modular connectors are not acceptable.

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- K. Battery Back-up: The system to utilize a memory back-up device that is system integrated and non-serviceable. Protect the data in RAM against power interruptions lasting as long as 10 years. Provide maintenance free power interrupt protection circuit.
- L. Multi-tapped Transformer: The control panel incorporates the use of a multi-tapped transformer. No specification of voltage for each control location is required by panel. The voltages of 120 and 277VAC available with each standard control panel.
- M. Status Indication of Relays: System to provide visible status indication of relays through the window of each control panel. Visual indication to disclose ON/OFF status and relay number.
- N. Lockable Enclosure: Enclose each control panel in a lockable NEMA Class 1 enclosure and provide pre-punched knockouts.
- O. Relays: Electrically held 20amp 120/277VAC relays. Relays must be specified Normally Open or Normally Closed. Rate the relays for 10 million mechanical operations.
  - 1. Standard Relay Card (SRM-NO): System to utilize normally open control relays, which are rated to 20 amps at 120/277VAC. Magnetically hold the relays and provide on a card of eight relays per card. Provide wire terminations able to accept 10 AWG. Rate the relays for 10 million mechanical operations. Provide a limited 10-year warranty on the individual relay cards. Systems that do not offer a limited 10-year warranty on installations are not acceptable.
  - 2. Monitoring/Control Software: The PC based interface software accessory provides access to lighting control system files within a Microsoft® Windows® environment. Provide software to support Windows® 2000, Windows® XP and above. The software package allows individual panel programming to be executed locally, via direct connection or remotely through a TCP/IP connection or modem. The central programming software permits the user to modify the control panel programming or configuration in an "OFF-LINE" mode. This software package stores programmed data and archives for future use. Systems using third party software are not acceptable. Systems that are not capable of creating program backups are not acceptable.
    - a. Provide the following features standard in the PC based software:
      - 1) Standard Software Features:
      - 2) Real Time Relay Status Monitoring
      - 3) Alpha-Numeric Descriptors
      - 4) Communications: Direct, TCP/IP and Modem
      - 5) Status Indication
      - 6) Global Software Modifications
      - 7) Manual Relay Commands
      - 8) Relay Pattern Commands
      - 9) Preset Options
      - 10) User Management - Password protection and privilege modification for multi-user security.
      - 11) Logging of Controller Actions (switch inputs, TIM commands and relay actuations)
    - b. File Maintenance
      - 1) Archive Programs
      - 2) Data Base Restoration
      - 3) Uploading and Downloading of Programs
      - 4) Snap Shots - indication of changes and flawless panel restoration.
    - c. Software package to permit the PC to be utilized for other functions (i.e. word processing, database, etc.) besides lighting control. Systems that require an "on-line" dedicated computer for control system operation are not acceptable.
  - 3. Stand Alone Hardware Accessories:
    - a. Ethernet Interface Module (EIM): Internet Connection Specifications: The control system accessory provides access to control panels over a TCP/IP connection by

converting sent information into RS-232 communication capable information. This unit operates on standard 110VAC. Manufacturer to provide proper cabling from controller to Ethernet Interface Modules. RJ-45 connections are the responsibilities of others.

### **PART 3 - EXECUTION**

#### **3.01 GENERAL INSTALLATION REQUIREMENTS**

- A. Installation: Install the control system and fully wire as shown on the drawings by the installing contractor. Complete electrical connections to control circuits, and override wiring.
- B. Documentation: Provide accurate record drawings to the Owner for correct programming and proper maintenance of the control system. Record Drawings to indicate the load controlled by each relay and the relay panel number.
- C. Operation and Maintenance Manuals: Provide factory operation and maintenance manuals.
- D. Emergency and Standby Circuits: Provide NC contacts for switching circuits on backup power, so that if the relay panel loses power, the circuits default to ON.

#### **3.02 PRODUCT SUPPORT AND SERVICE**

- A. Factory Support: Provide factory telephone support available at no cost to the Owner. Factory assistance to consist of solving programming or application questions concerning the control equipment.

#### **3.03 SYSTEM ACCEPTANCE**

- A. Test to ensure that control devices, components, equipment and systems are calibrated, adjusted and operate in accordance with approved drawings and specifications.
- B. Functionally test sequences of operation to ensure operation in accordance with approved drawings and specifications.
- C. Prepare and complete report of test procedures and results and file with the Owner.
- D. An operational user program to exist in the control system. Program to execute and perform functions required to effectively operate the site according to the requirements.
- E. Demonstration of program integrity during normal operation and pursuant to a power outage.
- F. Provide a minimum of 2 hours training on the operation and use of the control system.
- G. Lighting System Control Testing and Commissioning:
  - 1. Test lighting controls to ensure that control devices, components, equipment and systems are calibrated, adjusted and operate in accordance with Drawings and Specifications. Provide functional testing of sequences of operation to ensure operation in accordance with Drawings and Specifications. Provide complete report of test procedures and results to engineer and insert approved copy into project closeout documents.
  - 2. Testing to Include:
    - a. Daylight Automatic Controls
    - b. Occupant Sensing Automatic Controls
    - c. Automatic Time and Override Controls for Interior Lighting
    - d. Automatic Time and Photo Controls for Exterior Lighting

**END OF SECTION**

**SECTION 260923  
OCCUPANCY AND VACANCY SENSORS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Occupancy/Vacancy Sensors (Ceiling Mounted)
  - 2. Combined Occupancy Sensor/Wall Switches ("Sensor/Switches")

**1.02 RELATED SECTIONS**

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Provide wiring diagrams indicating low voltage and line voltage wiring requirements.
  - 2. Provide, on reproducible architectural floor plan, a layout of sensors indicating their sensing distribution.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Use manufacturer's published testing and adjusting procedures to adjust sensors time delay, daylight sensitivity, and passive infrared sensitivity to satisfaction of the Owner.
  - 2. Prepare and complete report of test procedures and results. Submit these test procedures and results to Owner and Architect.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

- A. Occupancy/Vacancy Sensors (Ceiling Mounted):
  - 1. Passive Infrared Occupancy/Vacancy Sensors:
    - a. Acuity Controls
    - b. WattStopper
    - c. Leviton
    - d. Hubbell
    - e. Cooper/Greengate
    - f. Lutron
    - g. Or approved equivalent.
  - 2. Ultrasonic Occupancy/Vacancy Sensors:
    - a. Acuity Controls
    - b. WattStopper
    - c. Leviton
    - d. Hubbell

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- e. Cooper/Greengate
- f. Lutron
- g. Or approved equivalent.
- 3. Dual Technology Occupancy/Vacancy Sensors:
  - a. Acuity Controls
  - b. WattStopper
  - c. Leviton
  - d. Hubbell
  - e. Cooper/Greengate
  - f. Lutron
  - g. Or approved equivalent.
- B. Combined Occupancy/Vacancy Sensor:
  - 1. Acuity Controls
  - 2. Lutron
  - 3. WattStopper
  - 4. Leviton
  - 5. Hubbell
  - 6. Cooper/Greengate
  - 7. Or approved equivalent.
- C. Basis of Design: Occupancy/Vacancy sensor layout on Drawings are designed based on Acuity Controls product line. Approved manufacturers listed are allowed on condition of meeting the specified conditions including complete sensor coverage of the area controlled and switching of luminaires in the area controlled. Provide additional sensors and power switch packs as needed to provide the same level of functionality as shown on Drawings or required in Specifications. Remove and replace electrical equipment installed not meeting these conditions at no cost to Owner.

## 2.02 GENERAL

- A. Occupancy sensor designation indicates sensors automatically turn lights ON when the sensor detects the presence of a person and will automatically turn lights OFF when no presence is detected for a specified amount of time (automatic-on and automatic-off).
- B. Vacancy sensor designation requires someone to manually turn the lights ON. The sensor will then automatically turn the lights OFF when no presence is detected for a specified amount of time (manual-on and automatic-off).
- C. Provide occupancy sensors to sense presence of human activity within desired space and enable or disable on/off manual lighting control function provided by local switches.
- D. Upon detection of human activity by detector, sensor initiates time delay to maintain lights on for present period of time. Field adjustable time delay setting from 30 seconds to 15 minutes.
- E. Factory set sensors for maximum sensitivity.
- F. LED lamp built into sensor indicates when occupant is detected.
- G. Provide zero cross relay control with sensors and sensor/switched; relay contacts close and open with AC voltage signal is at zero.
- H. Where line voltage sensors and sensor/switches are used, provide to match voltage of controlled circuit.
- I. Line Voltage Sensors, Control Units, and Relays: UL listed.

## 2.03 OCCUPANCY/VACANCY SENSORS (CEILING MOUNTED)

- A. Passive Infrared Sensors:
  - 1. Sensor Function: Detects human presence in floor area being controlled by detecting changes in Infrared energy. Sensor detects small movements, i.e., when people are

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- writing while seated at a desk.
2. Provide temperature compensated dual element pyro-electric sensor and with multi element Fresnel lens.
  3. Sensor utilizes DIP switches for adjustment to time delay and override. Field adjustable settings for sensitivity.
  4. Provide daylight filter to ensure that sensor is insensitive to short-wavelength infrared waves, i.e., those emitted by sun.
  5. Adjustments and mounting hardware under removable cover to prevent tampering with adjustments and hardware.
  6. Sensor utilizes advanced digital signal processing technology to reduce false offs without reducing sensitivity.
  7. Ceiling-Mounted Sensor:
    - a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
    - b. 360 degree sensor range; coverage: 1200 SF, unless otherwise noted on drawings.
    - c. Low Voltage Sensor: 24VDC power. Sensor operates remote power switch packs. Multiple sensors can be wired in parallel allow coverage of large areas.
    - d. Provide internal form C dry contacts for HVAC control.
- B. Ultrasonic Occupancy/Vacancy Sensors:
1. Sensor Function: Detects human presence in controlled floor area by detecting Doppler shifts in 40kHz ultrasound created by sensor.
  2. Sensors are precision crystal controlled and do not interfere with each other when two or more are placed in same area. Sensor includes advanced digital signal processing to reduce false on signals without decreasing sensitivity, as well as immunity to RFI/EMI sources.
  3. Sensor utilizes DIP switches for adjustment to time delay and override. Field adjustable settings for sensitivity.
  4. Low Voltage Sensor: 24VDC power. Sensor operates remote power switch packs. Multiple sensors can be wired in parallel allow coverage of large areas.
  5. Provide adjustments and mounting hardware under removable cover to prevent tampering.
  6. Ceiling-Mounted Sensor:
    - a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
    - b. Maximum protrusion of 1.1-inches and blend in aesthetically with ceiling.
    - c. Coverage: 360 degree sensor range; coverage: 2,000 SF, unless otherwise noted on Drawings.
    - d. Provide internal form C dry contacts for HVAC control.
  7. Ceiling Mounted Sensor - Hallway Sensor Coverage:
    - a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
    - b. Maximum protrusion of 1.5-inches and blend in aesthetically with ceiling.
    - c. Coverage: 90 linear feet.
    - d. Provide internal form C dry contacts for HVAC control.
- C. Dual Technology Sensors:
1. Sensor Function: Combined capability of passive infrared with ultrasonic or microphonic technology as described above.
  2. Function: Upon a person entering a space, motion must be sensed by both technologies before lighting will be turned on. After this has occurred, detection by either technology will hold lighting on. Sensors retrigger time delay where only one motion is necessary to turn on lights within 5 seconds after turning off.
  3. Ceiling-Mounted Sensor:

- a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
- b. 360 degree sensor range; coverage: 1000 SF for half-step motion, unless otherwise noted on Drawings.
- c. Low Voltage Sensor: 24VDC power. Sensor operates remote power switch packs. Multiple sensors can be wired in parallel allow coverage of large areas.
- d. Provide internal form C dry contacts for HVAC control.

#### **2.04 COMBINED OCCUPANCY/VACANCY SENSOR/WALL SWITCHES ("SENSOR/SWITCHES")**

- A. Completely self-contained sensor system that fits into standard single gang box. Internal transformer power supply, latching dry contact relay switching mechanism compatible with electronic ballasts, compact fluorescent, and inductive loads. Triac and other harmonic generating devices are not allowed.
- B. Passive infrared sensor technology includes advanced signal processing to reduce false triggers without increasing sensitivity. LED indicator blinks when occupant sensed.
- C. Rated to switch loads: 800 watts incandescent or 120-volt ballast; 1000 watts 277 volt ballast. Zero-crossing technology switches lighting off when AC voltage is at zero, minimizes contact wear.
- D. Provide adjustable daylight feature that holds lighting "off" when desired footcandle level is present.
- E. Provide integral off override switch with no leakage current to load or ground.
- F. Vandal-resistant lens.
- G. Includes neutral wire to meet NEC.
- H. Finish: White.
- I. Alerts for impending shut-off: light flash, audible, both or none.
- J. Standard Sensor/Switch:
  1. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off). Factory set to manual on/auto off.
  2. 180 degree sensor range; coverage: 150 SF for desktop activity.
- K. Sensor/Slide Dimmer:
  1. Line voltage dimmer allows for adjustment of lighting levels from 100 percent to 10 percent; compatible with two-wire line voltage 100 percent to 10 percent electronic dimming ballasts. Separate manual button for override 'off' control.
  2. 180 degree sensor range; coverage: 300 SF for desktop activity.
- L. Passive Infrared Wall Switch Vacancy-Only Sensors:
  1. Operates only as a vacancy sensor (manual-on and automatic-off).
  2. Adjustable sensitivity (high, low presets).
- M. Dual Technology Wall Switch Vacancy-Only Sensors:
  1. Operates only as a vacancy sensor (manual-on and automatic-off).
  2. Adjustable sensitivity (high, medium, low, and off presets) individually for passive infrared and ultrasonic sensing.
- N. Passive Infrared Wall Dimmer Vacancy-Only Sensors:
  1. Operates only as a vacancy sensor (manual-on and automatic-off).
- O. Passive Infrared 0-10 V Wall Dimmer Vacancy-Only Sensors:
  1. Operates only as a vacancy sensor (manual-on and automatic-off).
- P. Dual Technology 0-10V Wall Dimmer Vacancy Sensors:
  1. Operates only as a vacancy sensor (manual-on and automatic-off).

### **PART 3 - EXECUTION**

#### **3.01 GENERAL INSTALLATION REQUIREMENTS**

- A. Install occupancy/vacancy sensors as directed by manufacturer's instructions. Complete connections to control circuits, occupancy sensors, power supply pack and low voltage wiring.
- B. Provide power packs for sensor to control number of circuits and/or switch legs within its area of coverage.
- C. Field adjust each sensor to maximize its coverage of room space.
- D. Relocate sensors with ultrasonic technology to avoid being closer to HVAC diffusers and power packs than recommended by manufacturer.
- E. Field set time delay for each device as defined in the lighting control matrix in the drawings.
- F. Coordinate HVAC control requirements with controls contractor prior to installation.
- G. Lighting System Testing and Commissioning:
  - 1. Test lighting controls to ensure that control devices, components, equipment and systems are calibrated, adjusted and operate in accordance with Drawings and Specifications. Provide functional testing of sequences of operation to ensure operation in accordance with Drawings and Specifications. Provide complete report of test procedures and results to engineer and insert approved copy into project closeout documents.
  - 2. Testing includes:
    - a. Daylight Automatic Controls
    - b. Occupant Sensing Automatic Controls
    - c. Automatic Time and Override Controls for Interior Lighting
    - d. Automatic Time and Photo Controls for Exterior Lighting

**END OF SECTION**



**SECTION 260924  
DAYLIGHTING CONTROLS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Local Continuous Dimming Photosensor

**1.02 RELATED SECTIONS**

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards per Division 01, General Requirements and Section 26 00 00, Electrical Basic Requirements.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Wiring diagrams indicating low voltage and line voltage wiring requirements.
  - 2. A layout of sensors indicating their sensing distribution on reproducible architectural floor plan.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Daylighting controls that carry a factory warranty for a minimum 5-year duration.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

- A. Local Continuous Dimming Photosensor:
  - 1. Acuity Controls
  - 2. WattStopper
  - 3. Greengate
  - 4. Leviton Lighting Controls
  - 5. Hubbell Control Solutions
  - 6. Or approved equivalent.
  - 7. Basis of Design: Daylighting sensor layout on Drawings are designed based on Acuity Controls product line. Approved manufacturers listed below are allowed on condition of meeting specified conditions including complete sensor coverage of area controlled and switching of luminaires in area controlled. Provide additional sensors and power switch packs as needed to provide same level of functionality as shown on Drawings. Remove and replace electrical equipment installed not meeting these conditions at no cost to Owner.

**2.02 LOCAL CONTINUOUS DIMMING PHOTOSENSOR**

- A. Provide low voltage, indoor photocell to interface with electronic dimming ballasts using low voltage (0 to 10VDC) control signal.

- B. Spectral filtering system to measure relative levels of daylighting and indoor lighting within control space. Measures light as human eye perceives; linear photocell response with greater than 1 percent accuracy.
- C. Ceiling-mounted 2.4-inch diameter, 0.875-inch depth white housing.
- D. 10VDC input voltage, 0.2 to 10VDC output voltage. 20 to 60 footcandle adjustable range with plus or minus 3 percent accuracy. One photocell controls up to 50 drivers. 5 year warranty. White finish.
- E. Automatic Off Control.
- F. Provide with separate handheld remote controller to field program target lighting levels for daytime and nighttime (i.e. when plenty of daylighting is available and when no daylighting is available).

**PART 3 - EXECUTION**

**3.01 GENERAL INSTALLATION REQUIREMENTS**

- A. Install photocells as directed by manufacturer's instructions. Complete connections to control circuits, photocells, control modules, power supply pack and low voltage wiring.
- B. Photocell placement and wiring:
  - 1. Drawings are schematic, and show photocell quantities together with the daylighting zones that they control.
  - 2. Reference manufacturer installation instructions for the recommended location and orientation of photocell with respect to exterior glazing and both interior and exterior lighting.
  - 3. Reposition sensor at no additional cost to Owner to avoid conflict between sensor and object obscuring its view, and between sensor and both interior and exterior lighting that causes daylighting controls to repeatedly increase and decrease in brightness (i.e. "cycling").
  - 4. Field wire photocell for correct footcandle range.

**3.02 LIGHTING SYSTEM CALIBRATION, DEMONSTRATION, TRAINING, TESTING AND COMMISSIONING**

- A. Prior to adjusting and calibrating daylighting control system and local photocell field adjustable settings, contact local manufacturer representative and arrange for representative to visit site to educate both field installer and Owner's Authorized Representative on the operation of the controls.
- B. Use manufacturer's published testing and adjusting procedures to adjust sensors and daylight sensitivity to the satisfaction of Owner.
- C. Daylight Dimming Zone Calibration:
  - 1. After all furniture is installed, all daylighting zones are to be field calibrated using a digital photometer. Adjust photocell and control system parameters to maintain an even light level at the work plane.
  - 2. Single and dual daylighting zones are to be adjusted to maintain an even light level at the work plane throughout connected zones and adjoined areas.
- D. Daylight Dimming Zone Lighting Level Setpoints:

Area	Setpoint (Average Footcandles)
Open Offices	30 FC
Private Offices	40 FC
Conference Rooms	30 FC
Corridors	5 FC
Lobby	10 FC

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- E. Prepare and complete report of test procedures and results including the final daylighting level setpoints as set while using a digital photometer. Submit these test procedures and results to Engineer and Commissioning Authority.
- F. Test lighting controls to ensure that control devices, components, equipment and systems are calibrated, adjusted and operate in accordance with Drawings and Specifications. Provide functional testing of sequences of operation to ensure operation in accordance with Drawings and Specifications. Provide complete report of test procedures and results to Engineer and insert approved copy into project closeout documents.
- G. Testing Includes:
  - 1. Daylight Automatic Controls
  - 2. Occupant Sensing Automatic Controls
  - 3. Automatic Time and Override Controls for Interior Lighting
  - 4. Automatic Time and Photo Controls for Exterior Lighting
- H. Training: Provide minimum 2-hour training session to Owner's Authorized Representatives at a time approved by Owner after Owner has received approved operation and maintenance manuals. Training to include discussion of operation, adjustment, and replacement of sensors, photocells and control.

**END OF SECTION**

**SECTION 262416  
PANELBOARDS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Panelboards

**1.02 RELATED SECTIONS**

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
  - 1. Section 26 05 73, Electrical Distribution System Studies.
  - 2. Section 26 28 00, Overcurrent Protective Devices.
  - 3. Section 26 43 00, Surge Protective Devices

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. UL 67, Standards for Panelboards.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

- A. Panelboards:
  - 1. Eaton
  - 2. ABB/General Electric
  - 3. Siemens
  - 4. Basis of Design: Schneider Electric/Square D
  - 5. Or approved equivalent.
- B. Manufacturers listed above are allowed on condition of meeting specified conditions including available space for equipment, Code required working clearances, selective coordination per Section 26 05 73, Electrical Distribution System Studies, and amps interrupting capacity (AIC) per short circuit study in Section 260573, Electrical Distribution System Studies. Prior to submitting bid, manufacturer to provide documentation to Engineer verifying specific conditions, including those mentioned above, can be met. Remove and replace electrical equipment installed, at no cost to the Owner, that does not meet these conditions.

**2.02 PANELBOARDS**

- A. Description: Panelboards 400 amps or less. NEMA PB1, Type 1 or as indicated on drawings, circuit breaker type. Maximum enclosure depth: 6-inches for surface mounted, 5-3/4-inches for flush mounted.

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- B. Maximum Width: 20-inches.
- C. Integrated Equipment Rating: Provide fully rated integrated equipment rating greater than the available fault current. Series rated panelboards are not acceptable. Reference drawings for available fault current. If drawings do not have available fault current shown, then coordinate with serving electrical utility. Final rating based on the protective device study completed under the provisions of Division 26, Electrical Distribution System Studies.
- D. Panelboard Bus Non-Reduced: Copper, ratings as indicated on drawings. Bus bar with suitable electroplating (tin) for corrosion control at connection. Provide copper ground bus in each panelboard.
- E. Lugs: Mechanical type for both aluminum and copper conductors. All device terminals/lugs shall be rated for a minimum of 75 degrees C to facilitate the use of 75 degrees C conductor ampacity rating.
- F. Provide double lugs and/or feed-through lugs for feed through feeders.
- G. Molded Case Circuit Breakers: Thermal magnetic trip circuit breakers, bolt-on type, with common trip handle for poles; UL listed. Predrill bus for bolt-on breakers.
  - 1. Type SWD for lighting circuits.
  - 2. Type HACR for air conditioning equipment circuits.
  - 3. Class A ground fault interrupter circuit breakers where scheduled.
  - 4. Class B ground fault equipment protection circuit breakers for heat trace and other circuits as required by Code. Provide shunt trip circuit breakers where scheduled; provide wiring to remote trip switch/contacts as indicated on Drawings.
  - 5. Do not use tandem circuit breakers.
- H. Accessories: Provide where indicated: Class A ground fault circuit interrupter (GFCI).
- I. Cabinet Front: Provide flush or surface mounting as shown on the schedules, drawings, or otherwise noted. Cabinet front with concealed hinged front cover construction, metal directory frame with heavy clear plastic protector, flush lift latch and lock, two keys per panel all keyed alike.
- J. Provide boxes with removable blank end walls and interior mounting studs. Provide interior support bracket for ease of interior installation.
- K. Furnish surface mounted cabinet boxes without knockouts.

### **PART 3 - EXECUTION**

#### **3.01 GENERAL INSTALLATION REQUIREMENTS**

- A. Install panelboards in accordance with NEMA PB 1.1, NECA 1 and manufacturers installation instructions.
- B. Install panelboards level and plumb. Install recessed panelboards flush with wall finishes.
- C. Height: 6-feet 6-inches to top of panelboard; install panelboards taller than 6-feet 6-inches with bottom no more than 4-inches above floor.
- D. Provide filler plates for unused spaces in panelboards.
- E. Provide typed circuit directory for each branch circuit panelboard. Include all "spaces" and "spares." Revise directory to reflect circuiting changes and as-installed conditions. Use final Owner designated room names and numbers, and not designations shown on drawings.
- F. Provide engraved plastic nameplates per Section 26 05 53, Identification for Electrical Systems.
- G. Provide arc flash labels per Section 26 05 73, Electrical Distribution System Studies.
- H. Provide two 1-inch spare conduits out of each recessed panelboard to an accessible location above ceiling. Identify each as SPARE.
- I. Provide permanent identification number in or on panelboard dead-front adjacent to each breaker pole position. Horizontal centerline of numbers to correspond with centerline of circuit

breaker pole position.

- J. Ground and bond panelboard enclosure per NEC.
- K. Paint:
  - 1. Standard factory finish unless noted otherwise.
  - 2. Panelboards located in finished interior areas in view of building occupants; paint to match adjacent wall surface. Color and paint preparation as specified by Architect. Covers to be painted off wall, then installed over dried, painted wall surface.
- L. Provide handle guards on each circuit supplying obviously constant loads such as fire alarm, security, lighting controls, refrigerators and freezers, fire protection, etc.
- M. Provide interior wiring diagram, neutral wiring diagram, UL label, and short circuit rating on interior or in booklet format inserted in sleeve inside panel cover.
- N. Verify available recessing depth and coordinate wall framing with other divisions.
- O. Maintain fire rating of wall where panels are installed flush in fire rated walls.
- P. Perform inspections and tests in accordance with manufacturer's requirements.
- Q. Thoroughly clean exterior and interior of each panelboard in accordance with manufacturer's installation instructions.
- R. Vacuum construction dust, dirt, and debris out of each panelboard.
- S. Where enclosure finish is damaged, touch up finish with matching paint in accordance with manufacturer's specifications and installation instructions.

### **3.02 PANELBOARDS INSTALLATION**

- A. Breakers being added to existing panelboards: Coordinate breaker type and short circuit rating with existing panelboard. Breakers to match existing in manufacturer's type and AIC rating. Provide new typed circuit directory.
- B. Provide handle tie to branch circuit breakers of multiwire branch circuits for simultaneous disconnection of circuits. Handle tie will be identified for use with circuit breakers provided. Reconfigure assigned circuits as necessary so that circuit breakers associate with multiwire branch circuits are physically adjacent, record changes in panelboard schedules and circuiting plans for record drawings.
- C. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

**END OF SECTION**

**SECTION 262713  
ELECTRICAL METERING**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Utility Metering Equipment

**1.02 RELATED SECTIONS**

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Product Data: List of components for power monitoring, including dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes. Attach copies of Submittals for effected products (such as switchboards and switchgear) that describe power monitoring features to coordinate Product Data related to power monitoring.
  - 2. Shop Drawings: Detail assemblies of standard components, custom assembled for specific application on this Project.
    - a. Outline Drawings: Indicate dimensions, weights, arrangement of components, and clearance and access requirements.
    - b. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.
    - c. Wiring Diagrams: Detail specific wiring to suit Project. Coordinate nomenclature and presentation with a block diagram, and differentiate between manufacturer-installed and field-installed wiring.
  - 3. Closeout Documentation: Documentation that details the start-up procedure being performed including a process to follow, details on tests performed, and an area that documents any test results.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Energy metering to be of a single-source manufacturer of the major components within the assembly. Manufacturer will have documented experience in the manufacture of energy metering for a minimum of three years.
  - 2. Installer will have documented experience in the installation of energy metering for a minimum of three years.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements Division 01, General Requirements.

## **1.07 COORDINATION**

- A. Coordinate features of distribution equipment and power monitoring components to form an integrated interconnection of compatible components.
  - 1. Match components and interconnections for optimum performance of specified functions.
  - 2. Coordinate Work of this Section with BAS to indicate and record designated alarms registered in power monitoring displays.
    - a. Coordinate power monitoring components so metered electrical load and demand values and associated summary and trend reports specified in this Section are made accessible to the BAS system.
    - b. Log and store data from power monitoring system to facilitate production of monthly reports associated with the facility.
    - c. Provide capacity to maintain logged data for a minimum of ten years. Provide auto archive capability and locally accessible storage.
- B. Coordinate Work of this Section with that in Sections specifying distribution components that are monitored by power monitoring equipment.
- C. Coordinate a communication link with BAS to meet input requirements of BAS integrator and gateway equipment provided as part of BAS installation.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Manufacturers:
  - 1. Utility Metering Equipment
    - a. Meter Base:
      - 1) Circle AW.
      - 2) Or approved equivalent.
    - b. Metering Equipment Enclosure:
      - 1) ABB/General Electric
      - 2) Schneider Electric/Square D
      - 3) Eaton Electrical
      - 4) Siemens
      - 5) Or approved equivalent.

### **2.02 UTILITY METERING EQUIPMENT**

- A. Meter Base: Surface or Flush mounted meter socket enclosure. Provide meter base(s) for energy/demand and reactive energy/demand bases as required by serving electric utility.
- B. Terminal Cabinet: Provide terminal cabinet that meets serving utility company's requirements. Construct as an integral part of main distribution switchboard.
- C. Provide fault withstand rating greater than utility determined available fault current.
- D. C.T. Enclosure: Provide enclosure that meets serving utility company's requirements. Construct as an integral part of main distribution switchboard.

## **PART 3 - EXECUTION**

### **3.01 UTILITY METERING INSTALLATION**

- A. Meter Bases: Locate to provide acceptable access for meter reading and maintenance. Locate to minimize risk of physical damage.
- B. Metering Equipment: Install current transformers supplied by serving electric utility.
- C. Verify utility requirements prior to bidding and provide associated work required by local utility including but not limited to:
  - 1. Service underground primary including conduit, pull cord, excavation and backfill.
  - 2. Underground pull vaults.



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3. Pole risers.
4. Transformer pads, and vaults.
5. Secondary service lateral raceways.
6. Grounding of transformers.
7. Service metering equipment.

**END OF SECTION**

**SECTION 262800  
OVERCURRENT PROTECTIVE DEVICES**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Fuses
  - 2. Molded Case Circuit Breakers

**1.02 RELATED SECTIONS**

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Product data and instantaneous let-through current curves and average melting time current curves for fuses supplied to project.
  - 2. Product data and time/current trip curves for circuit breakers supplied to project.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements apply to this Section.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

- A. Fuses:
  - 1. Bussmann
  - 2. Ferraz-Shawmut
  - 3. Littelfuse
  - 4. McGraw-Edison
  - 5. Or approved equivalent.
- B. Molded Case Circuit Breakers:
  - 1. Eaton Electrical
  - 2. ABB/General Electric
  - 3. Siemens
  - 4. Schneider Electric/Square D
  - 5. Or approved equivalent.

**2.02 FUSES**

- A. Characteristics:
  - 1. Dual element, time delay, current limiting, nonrenewable type, rejection feature.
  - 2. Combination Loads: UL Class RK1, RK5, or J, 1/10 to 600 amp. UL Class L, above 600 amps.
  - 3. Motor Loads: UL Class RK5, 1/10 to 600 amp.
  - 4. Fuse pullers for complete range of fuses.

### **2.03 MOLDED CASE CIRCUIT BREAKERS**

- A. 1-, 2- or 3-pole bolt-on, single handle common trip, 600VAC or 250VAC as indicated on Drawings.
- B. Overcenter toggle-type mechanism, quick-make, quick-break action. Trip indication is by handle position.
- C. Calibrate for operation in 40 degrees C ambient temperature.
- D. 15 to 150 Amp Breakers: Permanent trip unit containing individual thermal and magnetic trip elements in each pole.
- E. 151 to 400 Amp Breakers: Adjustable magnetic trip elements. Provide push-to-trip button on cover of breaker for mechanical tripping.
- F. Greater than 401 Amp: Electronic trip type with adjustments for long-time, instantaneous, and short-time functions.
- G. Circuit breakers 1200 Amp and Greater: Provide breaker with energy-reducing maintenance switching with local status indicator per NEC Article 240.87(B).
- H. Provide ground fault function for breakers greater than 800 amps where applied at 480 volts line-to-line; and where indicated on drawings.

## **PART 3 - EXECUTION**

### **3.01 GENERAL INSTALLATION REQUIREMENTS**

- A. Coordination:
  - 1. Obtain and review the submitted product data for equipment furnished by the Owner, and furnished under other Divisions of this contract, particularly under Divisions 22 and 23.
  - 2. Confirm the equipment nameplate maximum overcurrent protection (MOCP) and make accommodations and adjustments to overcurrent protective devices as necessary to coordinate with the nameplate rating.
- B. Install all items in accordance with manufacturers written instructions.

### **3.02 FUSES**

- A. Fuses: For each class and ampere rating of fuse installed, provide the following quantities of spares for quantity of fuses installed:
  - 1. 0 to 24: Provide 6 spare.
  - 2. 25 to 48: Provide 9 spare.
  - 3. 49 and Above: Provide 12 spare.

### **3.03 MOLDED CASE CIRCUIT BREAKERS**

- A. Provide testing of ground fault interrupting breakers.
- B. Provide circuit breakers, as specified and on Drawings, for installation in panelboards, individual enclosures or combination motor starters.
- C. Provide ground fault interrupter circuit breakers for equipment in damp or wet locations.
- D. Provide device on handle to lock breaker in "ON" position for breakers feeding time switches, night lights and similar circuits required to be continuously energized.
- E. Provide multi-pole branch circuit breakers for multiwire branch circuits for simultaneous disconnection of circuits.

**END OF SECTION**

**SECTION 262816  
ENCLOSED SWITCHES AND CIRCUIT BREAKERS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Toggle Type Disconnect Switches
  - 2. Safety Switches

**1.02 RELATED SECTIONS**

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
  - 1. Section 26 05 73, Electrical Distribution System Studies.
  - 2. Section 26 24 16, Panelboards.
  - 3. Section 26 28 00, Overcurrent Protective Devices.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

- A. Toggle Type Disconnect Switches:
  - 1. Cooper
  - 2. Hubbell
  - 3. Leviton
  - 4. Legrand (Pass & Seymour)
  - 5. Slater
  - 6. Or approved equivalent.
- B. Safety Switches:
  - 1. Eaton Electrical
  - 2. ABB/General Electric
  - 3. Siemens
  - 4. Schneider Electric/Square D
  - 5. Or approved equivalent.

**2.02 TOGGLE TYPE DISCONNECT SWITCHES**

- A. Rating: 120 or 277 volt, 1 or 2 pole, 20 amp, 1 hp maximum.
- B. Enclosure:
  - 1. NEMA 1: Dry locations/Indoors.
  - 2. NEMA 3R: Damp or wet locations/Outdoors.

- C. Handle lockable in 'off' position.

### **2.03 SAFETY SWITCHES**

- A. Heavy duty fusible type and non-fusible type (as indicated on drawings), dual rated, quick-make, quick-break with fuse rejection feature for use with Class R fuses only, unless other fuse type is specifically noted.
- B. Clearly marked for maximum voltage, current, and horsepower.
- C. Operable handle interlocked to prevent opening front cover with switch in 'on' position.
- D. Switches rated for maximum available fault current.
- E. Handle lockable in 'off' position.
- F. Enclosure:
  - 1. NEMA 1: Dry locations/Indoors.
  - 2. NEMA 3R: Damp or wet locations/Outdoors.
- G. Fusible Switch Assemblies: NEMA KS 1, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Provide fuse rejection feature for Class R or J fuses up to 600 amp. Remove if circuit breaker type is used. Provide switches of 30 to 200 amp with plug-on line side connections.
- H. Fusible Switch Assemblies, 800 Amperes and Larger: Bolted pressure contact switches. Fuse Clips: Designed to accommodate Class L fuses. Provide with shunt-trip and ground fault capabilities. Remove if circuit breaker type is used.

## **PART 3 - EXECUTION**

### **3.01 GENERAL INSTALLATION REQUIREMENTS**

- A. Obtain and review the submitted product data for equipment furnished by the Owner, and furnished under other Divisions of this contract, particularly under Divisions 22 and 23.
- B. Confirm the equipment nameplate maximum overcurrent protection (MOCP) and make accommodations and adjustments to switches, fuses and circuit breakers as necessary to coordinate with the nameplate rating
- C. Install in accordance with manufacturer's instructions.
- D. Provide engraved nameplates per Section 26 05 53, Identification for Electrical Systems.
- E. Provide arc flash labels per Section 26 05 73, Electrical Distribution System Studies.
- F. Apply neatly typed adhesive tag on inside door of each fusible switch indicating NEMA fuse class and size installed.

### **3.02 TOGGLE TYPE DISCONNECT SWITCHES**

- A. Install fuses in fusible disconnect switches. Coordinate fuse ampere rating with installed equipment. Do not provide fuses of lower ampere rating than motor starter thermal units.
- B. Install products, systems and equipment in accordance with manufacturer's written instructions and requirements.
- C. See General Installation Requirements above.

### **3.03 SAFETY SWITCHES**

- A. Install products, systems and equipment in accordance with manufacturer's written instructions and requirements.
- B. See General Installation Requirements above.

**END OF SECTION**

**SECTION 264300  
SURGE PROTECTIVE DEVICES**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. SPD for Service Entrance - Modular Type
- B. Supply and install the Surge Protective Devices (SPD) having the electrical characteristics, ratings and modifications as specified herein and as shown on the contract drawings.

**1.02 RELATED SECTIONS**

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Listed per UL 1449, third edition, and complimentary listed per UL 1283 as FRI/EMI filter.
  - 2. Comply with ANSI/IEEE C62.45 test procedures for Category-C3 established in C62.41.2 and CSA certified (C22.2).

**1.04 SUBMITTALS**

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Related SPD Specifications, Drawings, maintenance manuals, installation instructions, and UL 1449, third edition, listed surge suppression ratings of specified protection modes.
  - 2. Project Record Documents: Record actual locations of SPDs.
  - 3. Maintenance Data:
    - a. Include module replacement instructions.
    - b. Include maintenance and troubleshooting instructions for electronic components.

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Manufacturer's Qualifications: ISO 9001 certification SPD manufacturers complete quality control and documentation procedures of firms regularly engaged in manufacture of SPD product for Category-C3 (ANSI/IEEE C62.41.2) and whose product has been of satisfactory service for not less than 5 years.
    - a. Provide local support for SPD.
    - b. Provide both service entrance and distribution panel SPD of same manufacturer.
  - 2. Manufacturer Qualifications: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

**1.06 WARRANTY**

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

- A. Advanced Protection Technologies, Inc. (APT)
- B. Current Technology

- C. Eaton Electrical
- D. Lea International
- E. Liebert
- F. Schneider Electric/Square D
- G. Surge Suppression Inc. (SSI)
- H. Siemens
- I. Or approved equivalent.

**2.02 SPD FOR SERVICE ENTRANCE - MODULAR TYPE**

- A. List SPD in accordance with UL 1449 (third edition), Standard for Safety, Surge Protective Devices, and UL 1283, Electromagnetic Interference Filters.
- B. Independently test SPD with Category-C3 high exposure waveform (20KV - 1.2/50  $\mu$ s, 10 kA - 8/20  $\mu$ s) per ANSI/IEEE C62.41.2.
- C. Provide SPD with copper bus bars for surge current path. Small gauge round wiring, plug-in type connections, or printed circuit boards not to be used in path for surge current diversion. Equally distribute surge current to individually fused MOV components to ensure equal stressing and maximum performance. Surge suppression platform must provide equal impedance paths to each matched (plus or minus one volt) MOV.
- D. Construct SPD using field replaceable surge current diversion modules (MOV based). Each module fused with user replaceable 200,000 AIC rated fuses. Monitor status of each module and MOV and indicate on front of SPD's enclosure as well as on each module.
- E. Encapsulated SPD, whether modular or chase nipple units, utilizes an encapsulant that is UL listed and holds 94-V2 fire retardant rating. Allow no encapsulant compounds that incorporate epoxy.
- F. Equip SPD with an audible alarm that activates when one of surge current modules have failed. Provide an alarm on/off switch to silence the alarm. Provide an alarm push-to-test switch to test alarm. Locate switches and alarm on front cover of SPD's enclosure. Equip unit with an Event Counter that will indicate how many surges, sags, swells and outages have occurred at the location.
- G. Meet or exceed the following criteria:
  - 1. Maximum Single Impulse Current Rating: No less than 200 or 300 kA per phase. Manufacturers must provide documented proof of independent third party verification of single impulse current withstand capabilities.
  - 2. Pulse Life Test: Capable of protecting against and surviving 5000 ANSI/IEEE C62.41.2 Category-C3 transients without failure or degradation of UL 1449, third edition, clamp voltage by more than 10 percent.
  - 3. UL 1449, third edition, clamping voltage not-to-exceed exceed the following:
 

VOLTAGE	L-G	L-N	N-G
208Y/120V	800V	800V	800V
  - 4. ANSI/IEEE C62.41.2 (2002) Category-C3 clamping voltage not to exceed the following:
 

VOLTAGE	L-N	L-5	N-G
208Y/120V	470V	470V	470V
- H. Provide response time that is no greater than five nanoseconds for any of individual protection modes.
- I. Provide SPD designed to withstand maximum continuous operating voltage (MCOV) of not less than 115 percent of nominal RMS voltage.

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1. Provide visible indication of proper SPD connection and operation. Indicator lights indicates which phase as well as which module is fully operable.
2. Equip SPD with the following items:
  - a. Provide connector along with dry contacts (normally open or normally closed) to allow connection to remote monitoring system.
  - b. Output of dry contacts indicates failure of phase or entire unit.
3. Provide terminals for necessary power and ground connections.
4. Provide SPD with minimum EMI/RFI filtering of 30dB at 100KHZ with an insertion loss ratio of 316:1 using Military Standard 220A methodology.
5. Provide SPD with 10 year warranty, incorporating unlimited replacement parts if they are destroyed by transients during warranty period.

**PART 3 - EXECUTION**

**3.01 SPD FOR SERVICE ENTRANCE - MODULAR TYPE INSTALLATION**

- A. Install SPD on load side of service entrance as directed by manufacturer's installation instructions. Provide 3 pole breaker for disconnect in service entrance equipment, size breaker to manufacturers installation instructions.
- B. Install one primary SPD at each utility service entrance to facility, according to manufacturer's recommendations.
- C. Integrate SPD unit into switch gear to maximize performance and reliability.
- D. Bond SPD's ground to service entrance ground.
- E. Maintenance Materials
  1. Furnish the following for Owner's use in maintenance of project:
    - a. Replacement modules: One of each type and size.

**END OF SECTION**



**SECTION 265100  
LIGHTING**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work Included:
  - 1. Luminaires
  - 2. LED Drivers
  - 3. Lamps
  - 4. Lighting Poles
- B. Provide wiring for complete and operating lighting system.

**1.02 RELATED SECTIONS**

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

**1.03 REFERENCES AND STANDARDS**

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. NECA 500 - Commercial Lighting.
  - 2. UL 8750 - Light Emitting Diode (LED) equipment for use in lighting products.

**1.04 SUBMITTALS**

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Submit product data for:
    - a. LED Luminaires: Electrical ratings, dimensions, mounting, material, clearances, terminations, wiring, connection diagram, LM-79 photometric data, LM-80 lumen depreciation data.
    - b. LED Drivers
    - c. Lamps
    - d. Lighting Poles
  - 2. Submittal Cutsheets: Highlight, circle or otherwise graphically indicate which option(s) are being selected for the products submitted. Cutsheets that are not edited to indicate which products and options are submitted for this project or that list only catalog numbers to identify submitted options are not acceptable.
  - 3. Specified manufacturers are approved to submit bid. However, inclusion does not relieve manufacturer from supplying product as described.
  - 4. Provide the following operating and maintenance instructions as required by Section 26 00 00, Electrical Basic Requirements:
    - a. Luminaires
    - b. LED Drivers
    - c. Lamps
    - d. Lighting Poles

**1.05 QUALITY ASSURANCE**

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Provide luminaires acceptable to code authority for application and location installed.
  - 2. Comply with applicable ANSI standards.

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3. Comply with applicable NEMA standards.
4. Provide luminaires and lampholders that comply with UL standards and have been listed and labeled for location and use indicated by a testing agency acceptable by the AHJ (e.g., UL, ETL, and the like).
5. Comply with OESC as applicable to installation and construction of luminaires.
6. Comply with fallout and retention requirements of OSSC for diffusers, baffles, and louvers.
7. Provide LED luminaires from the same manufacturer and manufacturing LED source batch for similar applications (e.g., all LED downlights from a single manufacturer and batch, all linear LED products from single manufacturer and batch).

#### **1.06 WARRANTY**

- A. Warranty as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
  1. LED Luminaire Manufacturer's Warranty: Not less than 5 years for luminaire based on date of substantial completion. Includes normal cost of labor to replace luminaire. Replacement luminaire will match physical dimensions, physical appearance, chromaticity, lumen output and photometric characteristics of original installed equipment.

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Luminaires:
  1. Reference description and manufacturers in Luminaire Schedule on Drawings.
  2. Or approved equivalent.
- B. LED Drivers:
  1. Indoor Drivers:
    - a. eldoLED Series
    - b. Advance/Philips
    - c. Osram Sylvania
    - d. Or approved equivalent.
  2. Outdoor Drivers:
    - a. Advance/Philips
    - b. Osram Sylvania
    - c. LG
    - d. Or approved equivalent.
- C. Lamps:
  1. LED (Light Emitting Diode) Lamps:
    - a. Nichia
    - b. Cree
    - c. Osram Sylvania
    - d. GE Lumination
    - e. Or approved equivalent.
  2. Unless specific manufacturer not shown on this list is indicated in the Luminaire Schedule.
  3. Special types as indicated in Luminaire Schedule.
  4. Or approved equivalent.
- D. Lighting Poles:
  1. Reference description and manufacturers in Luminaire Schedule on Drawings.
  2. Or approved equivalent.

#### **2.02 LUMINAIRES**

- A. Luminaires: Reference description and manufacturers in Luminaire Schedule on Drawings.

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- B. Where recessed luminaires are installed in cavities intended to be insulated, provide IC rated luminaires or other code approved installation.
- C. UL label luminaires installed under canopies, roof or open porches, and similar damp or wet locations, as suitable for damp or wet location.
- D. Suspended luminaires: Provide minimum 24-inch adjustability in aircraft cable length where used.
- E. Recessed Luminaires: Frame compatible with ceiling material installed at particular luminaire location. Provide proper factory trim and frame for luminaire to fit location and ceiling material. Verify with Architectural Reflected Ceiling Plan prior to submittals.
- F. Finishes:
  - 1. Manufacturer's standard finish (unless otherwise indicated) over corrosion resistant primer.
  - 2. Interior Light Reflecting Finishes: White or specular finish with not less than 85 percent reflectance.
  - 3. Exterior Finishes: As detailed in Luminaire Schedule or on Drawings. Refer cases of uncertain applicability to Architect for resolution prior to release for fabrication.
- G. Light Transmitting Components:
  - 1. Plastic diffusers, molded or extruded of 100 percent virgin acrylic.
  - 2. Prismatic acrylic, extruded, flat diffusers, 0.125-inch overall thickness, unless otherwise noted.
- H. LED Luminaires:
  - 1. UL listing of luminaire includes drivers, transformers, enclosures, rated wire, communications devices and accessories needed for a complete and functional system.
  - 2. LM-79: Testing and measurement of absolute photometry, chromaticity (CCT) and luminaire power. Report provided by DOE certified independent testing laboratory. CCT as specified in Luminaire Schedule.
  - 3. Standards: ANSI C78.377, LM-79 and LM-82 compliant for performance characteristics, photometry, colorimetry, efficacy and thermal characteristics.
  - 4. LM-80 + TM-21: Testing and measurement, and statistical prediction of LED lamp life. Report provided by DOE certified independent testing laboratory.
  - 5. LEDs in one module/luminaire: Supplied from same batch/bin and fall within 3-step MacAdam Ellipse, or as described in Luminaire Schedule, whichever is the more stringent requirement.
  - 6. Provide luminaires with integral LED thermal management system (heat sinking).
  - 7. Luminaires to be equipped with an LED driver that accepts 120V through 277V, 50Hz to 60Hz (universal). Component-to-component wiring within the luminaire will carry no more than 80 percent of rated current and be listed by UL for use at 600VAC at 302 degrees F/150 degrees C or higher. Plug disconnects to be listed by UL for use at 600VAC, 15A or higher.
  - 8. Provide luminaires with individual LED arrays/modules and drivers that are accessible and replaceable from exposed side of the luminaire.

### 2.03 LED DRIVERS

- A. General:
  - 1. Performance: Meet dimming range called out in Luminaire Schedule, free from perceived flicker or visible stroboscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, and stable when input voltage conditions fluctuate over what is typically experienced in a commercial environment. Demonstration of this compliance to dimming performance will be necessary for substitutions or prior approval.
  - 2. Ten-year expected life while operating at maximum case temperature and 90 percent non-condensing relative humidity.

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3. Minimum efficiency of 85 percent, power factor greater than or equal to 0.90, compliance with reduction of hazardous substances (RoHS). Rated for operating temperature range of area in which driver is installed.
  4. Limit inrush current to minimize breaker tripping.
    - a. Base specification: NEMA 410 standard for inrush current for electronic drivers.
    - b. Preferred Specification: Meet or exceed 30 milliamp-squared-seconds at 277VAC for up to 50 watts of load and 75 amps at 240 microseconds at 277VAC for 100 watts of load.
  5. Withstand up to a 1,000 volt surge without impairment of performance as defined by ANSI C62.41 Category A.
  6. No visible change in light output with a variation of plus/minus 10 percent line voltage input.
  7. Total Harmonic Distortion less than 10 percent and meet ANSI C82.11 maximum allowable THD requirements at full output. THD at no point in the dimming curve allows imbalance current to exceed full output THD.
  8. Support automatic adaptation, allowing for future luminaire upgrades and enhancements and deliver improved performance:
    - a. Adjustment of forward LED voltage, supporting 3V through 55V.
    - b. Adjustment of LED current from 150mA to 1.4A at the 100 percent control input point in increments of 1mA.
    - c. Adjustment for operating hours to maintain constant lumens (within 5 percent) over the 50,000 hour design life of the system, and deliver up to 20 percent energy savings early in the life cycle.
  9. Operate for a (+/- 10 percent) supply voltage of 120V through 277VAC at 60Hz.
  10. UL Recognized under the component program and modular for simple field replacement. Drivers that are not UL Recognized or not suited for field replacement will not be considered.
  11. Ability to provide no light output when the analog control signal drops below 0.3 V, or the DALI/DMX digital signal calls for light to be extinguished and consume 0.5 watts or less in this standby. Control dead band between 0.3V and 0.65V included to allow for voltage variation of incoming signal without causing noticeable variation in luminaire to luminaire output.
- B. Light Quality:
1. Over the entire range of available drive currents, driver to provide step-free, continuous dimming to black from 100 percent to 0.1 percent and 0 percent relative light output, or 100 percent to 1 percent light output and step to 0 percent where indicated. Driver to respond similarly when raising from 0 percent to 100 percent.
    - a. Driver must be capable of 20 bit dimming resolution for white light LED drivers or 15 bit resolution for RGBW LED drivers.
  2. Driver must be capable of configuring a linear or logarithmic dimming curve, allowing fine grained resolution at low light levels.
  3. Drivers to track evenly across multiple luminaires at all light levels, and must have an input signal to output light level that allows smooth adjustment over the entire dimming range.
  4. Driver and luminaire electronics to deliver illumination that is free from objectionable flicker as measured by flicker index (ANSI/IES RP-16-10). At all points within the dimming range from 100 percent to 0.1 percent luminaire will have:
    - a. LED dimming driver to provide continuous step-free, flicker free dimming similar to incandescent source.
    - b. Base specification: Based on IEEE PAR1789, minimum output frequency should be greater than 1250 Hz.
    - c. Preferred specification: Flicker index to be equal to incandescent, less than 1 percent at all frequencies below 1000 Hz.
- C. Control Input:

1. Provide control protocol to match lighting control system specified for use with luminaire.
2. 4-Wire (0-10V DC Voltage Controlled) Dimming Drivers:
  - a. Meet IEC 60929 Annex E for General White Lighting LED drivers.
  - b. Connect to devices compatible with 0 to 10V Analog Control Protocol, Class 2, capable of sinking 0.6 ma per driver at a low end of 0.3V. Limit the number of drivers on each 0-10V control output based on voltage drop and control capacity.
  - c. Meet ESTA E1.3 for RGBW LED drivers.

#### **2.04 LAMPS**

- A. Provide lamps for luminaires.
- B. Provide lamp catalogued for specified luminaire type.
- C. Incandescent Lamps: Not allowed unless noted in Luminaire Schedule.
- D. LED (Light Emitting Diode):
  1. LED manufacturer will include, but not be limited to, light source, luminaire, power supply and control interface with added components as needed for complete and functioning system.
    - a. Comply with ANSI chromaticity standard for classifications of color temperature. See Luminaire Schedule for specified LED lamp color and color temperature. UL or ETL listed and labeled.
    - b. Luminaire testing per IESNA LM-79 and LM-80 procedures.
    - c. Lamp life for white LEDs: 50,000 plus hours with lamp failure occurring when LED produces 70 percent of initial rated lumens.
    - d. Lamp life for color LEDs: 30,000 plus hours with lamp failure occurring when LED produces 50 percent of its initial rated lumens.
    - e. LED Drivers: Reverse polarity protection, open circuit protection, require no minimum load. Minimum 80 percent efficiency. Class A noise rating.
    - f. Dimming: LED system capable of full and continuous dimming.
    - g. Correlated Color Temperature (CCT): See Luminaire Schedule for selection of color temperature for each luminaire. Ranges given below reflect maximum allowable tolerances for color temperature range for each nominal CCT.
      - 1) Nominal CCT:
        - (a) 2700 K (2725 ± 145)
        - (b) 3000 K (3045 ± 175)
        - (c) 3500 K (3465 ± 245)
        - (d) 4000 K (3985 ± 275)
    - h. Color Rendering Index (CRI) to be greater than or equal to 80.
  2. Special types as indicated in Luminaire Schedule.

#### **2.05 LIGHTING POLES**

- A. Provide exterior light poles, with concrete bases or direct buried, which are structurally supportive of pole under design loading.
- B. Provide exterior poles clean and scratch free with base bolt covers to match pole and luminaire finish.
- C. Provide poles and pole bases rated for a minimum of 100 MPH, unless otherwise noted. Wind EPA loading for quantity and type of luminaire it supports with a 1.3 gust factor.
- D. Provide poles with gasketed handholes, stainless steel tamper resistant hardware, anchor bolts and ground lugs.
- E. Description:
  1. Material: Steel, Aluminum, Treated wood, or Concrete.
  2. Shape: Tapered round, Round, or Square.
  3. Finish: Galvanized, Primed for field painting, or Anodized.

4. Base: Embedded, Anchor, or Transformer.
5. Accessories: Slipfitter and Mast Arms.

### **PART 3 - EXECUTION**

#### **3.01 GENERAL INSTALLATION REQUIREMENTS**

- A. Install per manufacturer's written installation instructions and requirements.
- B. Install luminaires securely, in neat and workmanlike manner.
- C. Install luminaires of types indicated where shown and at indicated heights in accordance with manufacturer's written instructions and with recognized industry practices to ensure that luminaires comply with requirements and serve intended purposes.
- D. Wiring:
  1. Recessed luminaires to be installed using flexible metallic conduit or MC Cable as allowed by Section 26 05 19 with luminaire conductors spliced to branch circuit conductors in nearby accessible junction box over ceiling. Junction box fastened to building structural member within 6-feet of luminaire.
  2. Luminaires for lift out and removal from ceiling pattern without disconnecting conductors or defacing ceiling materials.
  3. Flexible connections where permitted to exposed luminaires; neat and straight, without excess slack, attached to support device.
  4. Install junction box, flexible conduit and high temperature insulated conductors for through wiring of recessed luminaires.
- E. Relamp luminaires which have failed lamps at substantial completion.
- F. Replace LED drivers deemed as excessively noisy by Architect, Engineer, or Owner.
- G. Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
- H. Support luminaires larger than 2- by 4-foot size independent of ceiling framing.
- I. Locate recessed ceiling luminaires as indicated on architectural reflected ceiling plan.
- J. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- K. Exposed Grid Ceilings:
  1. Support surface mounted luminaires in grid ceiling directly from building structure.
  2. Provide auxiliary members spanning ceiling grid members to support surface mounted luminaires.
  3. Fasten surface mounted luminaires to ceiling grid members using bolts, screws, rivets, or suitable clips.
- L. Install recessed luminaires to permit removal from below.
- M. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- N. Install clips to secure recessed grid-supported luminaires in place.
- O. Install wall mounted luminaires, emergency lighting units, and exit signs at height as indicated on Architectural Drawings.
- P. Install accessories furnished with each luminaire.
- Q. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- R. Bond products and metal accessories to branch circuit equipment grounding conductor.
- S. Install specified lamps in each emergency lighting unit, exit sign, and luminaire.

- T. Where manufactured wiring assemblies are used, ensure that wiring assembly manufacturer sends components to appropriate luminaire manufacturer for respective installation of proper components.
- U. Coordination:
  - 1. Coordination of Conditions: Coordinate ceiling construction, recessing depth and other construction details prior to ordering luminaires for shipment. Refer cases of uncertain applicability to Architect for resolution prior to release of luminaires for shipment. Where luminaires supplied do not match ceiling construction, replace luminaires at no cost to Owner.
  - 2. Electrical drawings are schematic, identifying quantity and type of luminaires used and their approximate location, but are not to be used for dimensional purposes. Reference architectural drawings for exact locations, including mounting heights.
  - 3. Provide lighting indicated on Drawings with luminaire of the type designated and appropriate for location.
  - 4. Provide LED luminaires with driver compatible to lighting control system as shown in drawings and as specified.
  - 5. Where remote drivers are required, ensure adequate accessibility to driver. Upsize conductors between luminaire and driver to accommodate voltage drop.
- V. Field Quality Control:
  - 1. Perform field inspection in accordance with Division 01, General Requirements.
  - 2. Operate each luminaire after installation and connection. Inspect for proper connection and operation.
- W. Cleaning:
  - 1. Clean electrical parts to remove conductive and deleterious materials.
  - 2. Remove dirt and debris from enclosures.
  - 3. Clean paint splatters, dirt, dust, fingerprints, and debris from luminaires.
  - 4. Clean photometric control surfaces as recommended by manufacturer.
  - 5. Clean finishes and touch up damaged finishes per by manufacturer's instructions.
- X. Demonstrate luminaire operation for minimum of two hours.

### **3.02 LUMINAIRES**

- A. Install per manufacturer's written installation instructions and requirements.
- B. Align, mount and level luminaires uniformly. Use ball hangers for suspended stem mounted luminaires.
- C. Avoid interference with and provide clearance from equipment. Where indicated locations for luminaires conflict with locations for equipment, change locations for luminaire by minimum distance necessary as directed by Architect.
- D. Suspended Luminaires: Mounting heights indicate clearances between bottom of luminaire and finished floors.
- E. Emergency Egress Luminaires: Provide unswitched circuit for battery charging and autotransfer circuiting for exit signs and luminaires with integral batteries. Where test switch cannot be integral to luminaire, mount remote test switch flush-to-ceiling and adjacent to egress luminaire.
- F. Interior Luminaire Supports:
  - 1. Support Luminaires: Anchor supports to structural slab or to structural members within a partition, or above a suspended ceiling.
  - 2. Maintain luminaire positions after cleaning and relamping.
  - 3. Support luminaires without causing ceiling or partition to deflect.
  - 4. Provide mounting supports for recessed and pendant mounted luminaires as required by IBC.
- G. Adjusting:

1. Aim and adjust luminaires as indicated.
2. Focus and adjust floodlights, spotlights and other adjustable luminaires, with Architect, at such time of day or night as required.
3. Align luminaires that are not straight and parallel/perpendicular to structure.
4. Position exit sign directional arrows as indicated.

### **3.03 LED DRIVERS**

- A. Install lamps per manufacturer's installation instructions and requirements.
- B. Where driver is remote mounted, size wiring based on type of driver, driver distance from luminaire, and voltage/power level, and manufacturer's installation instructions.
- C. Protect 0-10V input from line voltage mis-connection, and so it will be immune and the output unresponsive to induced AC voltage on the control leads.

### **3.04 LIGHTING POLES**

- A. Install lighting poles per manufacturer's installation instructions and requirements.
- B. Exterior Luminaire Supports:
  1. Provide concrete bases for pole-mounted lighting units and bollard lights at locations shown on site plan drawing(s). Provide concrete bases as shown on drawings or as recommended by manufacturer if not shown on drawings. Minimum base height above grade in automobile areas is 30-inches. Install luminaire poles plumb.
  2. Install pole concrete bases in undisturbed or compacted soil. Where soil is disturbed provide backfill and compaction per Division 31, Earthwork requirements.

**END OF SECTION**



**SECTION 270511  
 REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

- A. This section includes common requirements to communications installations and applies to all sections of Division 27 and Division 28.
- B. Provide completely functioning communications systems.
- C. Comply with VAAR 852.236.91 and FAR clause 52.236-21 in circumstance of a need for additional detail or conflict between drawings, specifications, reference standards or code.

**1.02 REFERENCES**

- A. Abbreviations and Acronyms
  - 1. Refer to <http://www.cfm.va.gov/til/sdetail.asp> for Division 00, ARCHITECTURAL ABBREVIATIONS.
  - 2. Additional Abbreviations and Acronyms:

A	Ampere
AC	Alternating Current
AE	Architect and Engineer
AFF	Above Finished Floor
AHJ	Authority Having Jurisdiction
ANSI	American National Standards Institute
AWG	American Wire Gauge (refer to STP and UTP)
AWS	Advanced Wireless Services
BCT	Bonding Conductor for Telecommunications (also Telecommunications Bonding Conductor (TBC))
BDA	Bi-Directional Amplifier
BICSI	Building Industry Consulting Service International
BIM	Building Information Modeling
BOM	Bill of Materials
BTU	British Thermal Units
BUCR	Back-up Computer Room
BTS	Base Transceiver Station
CAD	AutoCAD
CBOPC	Community Based Outpatient Clinic
CBC	Coupled Bonding Conductor
CBOC	Community Based Out Patient Clinic (refer to CBOPC, OPC, VAMC)
CCS	TIP's Cross Connection System (refer to VCCS and HCCS)
CFE	Contractor Furnished Equipment
CFM	US Department of Veterans Affairs Office of Construction and Facilities Management
CFR	Consolidated Federal Regulations

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CIO	Communication Information Officer (Facility, VISN or Region)
cm	Centimeters
CO	Central Office
COR	Contracting Officer Representative
CPU	Central Processing Unit
CSU	Customer Service Unit
CUP	Conditional Use Permit(s) – Federal/GSA for VA
dB	Decibel
dBm	Decibel Measured
dBmV	Decibel per milli-Volt
DC	Direct Current
DEA	United States Drug Enforcement Administration
DSU	Data Service Unit
EBC	Equipment Bonding Conductor
ECC	Engineering Control Center (refer to DCR, EMCR)
EDGE	Enhanced Data (Rates) for GSM Evolution
EDM	Electrical Design Manual
EMCR	Emergency Management Control Room (refer to DCR, ECC)
EMI	Electromagnetic Interference (refer to RFI)
EMS	Emergency Medical Service
EMT	Electrical Metallic Tubing or thin wall conduit
ENTR	Utilities Entrance Location (refer to DEMARC, POTS, LEC)
EPBX	Electronic Digital Private Branch Exchange
ESR	Vendor's Engineering Service Report
FA	Fire Alarm
FAR	Federal Acquisition Regulations in Chapter 1 of Title 48 of Code of Federal Regulations
FMS	VA's Headquarters or Medical Center Facility's Management Service
FR	Frequency (refer to RF)
FTS	Federal Telephone Service
GFE	Government Furnished Equipment
GPS	Global Positioning System
GRC	Galvanized Rigid Metal Conduit
GSM	Global System (Station) for Mobile
HCCS	TIP's Horizontal Cross Connection System (refer to CCS & VCCS)
HDPE	High Density Polyethylene Conduit
HDTV	Advanced Television Standards Committee High-Definition Digital Television

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HEC	Head End Cabinets (refer to HEIC, PA)
HEIC	Head End Interface Cabinets (refer to HEC, PA)
HF	High Frequency (Radio Band; Re FR, RF, VHF & UHF)
HSPA	High Speed Packet Access
HZ	Hertz
IBT	Intersystem Bonding Termination (NEC 250.94)
IC	Intercom
ICRA	Infectious Control Risk Assessment
IDEN	Integrated Digital Enhanced Network
IDC	Insulation Displacement Contact
IDF	Intermediate Distribution Frame
ILSM	Interim Life Safety Measures
IMC	Rigid Intermediate Steel Conduit
IRM	Department of Veterans Affairs Office of Information Resources Management
ISDN	Integrated Services Digital Network
ISM	Industrial, Scientific, Medical
IWS	Intra-Building Wireless System
LAN	Local Area Network
LBS	Location Based Services, Leased Based Systems
LEC	Local Exchange Carrier (refer to DEMARC, PBX & POTS)
LED	Light Emitting Diode
LMR	Land Mobile Radio
LTE	Long Term Evolution, or 4G Standard for Wireless Data Communications Technology
M	Meter
MAS	Medical Administration Service
MATV	Master Antenna Television
MCR	Main Computer Room
MCOR	Main Computer Operators Room
MDF	Main Distribution Frame
MH	Manholes or Maintenance Holes
MHz	Megahertz (10 <sup>6</sup> Hz)
mm	Millimeter
MOU	Memorandum of Understanding
MW	Microwave (RF Band, Equipment or Services)
NID	Network Interface Device (refer to DEMARC)
NEC	National Electric Code
NOR	Network Operations Room

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NRTL	OSHA Nationally Recognized Testing Laboratory
NS	Nurse Stations
NTIA	U.S. Department of Commerce National Telecommunications and Information Administration
OEM	Original Equipment Manufacturer
OI&T	Office of Information and Technology
OPC	VA's Outpatient Clinic (refer to CBOC, VAMC)
OSH	Department of Veterans Affairs Office of Occupational Safety and Health
OSHA	United States Department of Labor Occupational Safety and Health Administration
OTDR	Optical Time-Domain Reflectometer
PA	Public Address System (refer to HE, HEIC, RPEC)
PBX	Private Branch Exchange (refer to DEMARC, LEC, POTS)
PCR	Police Control Room (refer to SPCC, could be designated SCC)
PCS	Personal Communications Service (refer to UPCS)
PE	Professional Engineer
PM	Project Manager
PoE	Power over Ethernet
POTS	Plain Old Telephone Service (refer to DEMARC, LEC, PBX)
PSTN	Public Switched Telephone Network
PSRAS	Public Safety Radio Amplification Systems
PTS	Pay Telephone Station
PVC	Poly-Vinyl Chloride
PWR	Power (in Watts)
RAN	Radio Access Network
RBB	Rack Bonding Busbar
RE	Resident Engineer or Senior Resident Engineer
RF	Radio Frequency (refer to FR)
RFI	Radio Frequency Interference (refer to EMI)
RFID	RF Identification (Equipment, System or Personnel)
RMC	Rigid Metal Conduit
RMU	Rack Mounting Unit
RPEC	Radio Paging Equipment Cabinets (refer to HEC, HEIC, PA)

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RTLS	Real Time Location Service or System
RUS	Rural Utilities Service
SCC	Security Control Console (refer to PCR, SPCC)
SMCS	Spectrum Management and Communications Security (COMSEC)
SFO	Solicitation for Offers
SME	Subject Matter Experts (refer to AHJ)
SMR	Specialized Mobile Radio
SMS	Security Management System
SNMP	Simple Network Management Protocol
SPCC	Security Police Control Center (refer to PCR, SMS)
STP	Shielded Balanced Twisted Pair (refer to UTP)
STR	Stacked Telecommunications Room
TAC	VA's Technology Acquisition Center, Austin, Texas
TCO	Telecommunications Outlet
TER	Telephone Equipment Room
TGB	Telecommunications Grounding Busbar (also Secondary Bonding Busbar (SBB))
TIP	Telecommunications Infrastructure Plant
TMGB	Telecommunications Main Grounding Busbar (also Primary Bonding Busbar (PBB))
TMS	Traffic Management System
TOR	Telephone Operators Room
TP	Balanced Twisted Pair (refer to STP and UTP)
TR	Telecommunications Room (refer to STR)
TWP	Twisted Pair
UHF	Ultra-High Frequency (Radio)
UMTS	Universal Mobile Telecommunications System
UPCS	Unlicensed Personal Communications Service (refer to PCS)
UPS	Uninterruptible Power Supply
USC	United States Code
UTP	Unshielded Balanced Twisted Pair (refer to TP and STP)
UV	Ultraviolet
V	Volts
VAAR	Veterans Affairs Acquisition Regulation
VACO	Veterans Affairs Central Office
VAMC	VA Medical Center (refer to CBOC, OPC,

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	VACO)
VCCS	TIP's Vertical Cross Connection System (refer to CCS and HCCS)
VHF	Very High Frequency (Radio)
VISN	Veterans Integrated Services Network (refers to geographical region)
VSWR	Voltage Standing Wave Ratio
W	Watts
WEB	World Electronic Broadcast
WIMAX	Worldwide Interoperability (for MW Access)
WI-FI	Wireless Fidelity
WMTS	Wireless Medical Telemetry Service
WSP	Wireless Service Providers

B. Definitions:

1. Access Floor: Pathway system of removable floor panels supported on adjustable pedestals to allow cable placement in area below.
2. BNC Connector (BNC): United States Military Standard MIL-C-39012/21 bayonet-type coaxial connector with quick twist mating/unmating, and two lugs preventing accidental disconnection from pulling forces on cable.
3. Bond: Permanent joining of metallic parts to form an electrically conductive path to ensure electrical continuity and capacity to safely conduct any currents likely to be imposed to earth ground.
4. Bundled Microducts: All forms of jacketed microducts.
5. Conduit: Includes all raceway types specified.
6. Conveniently Accessible: Capable of being reached without use of ladders, or without climbing or crawling under or over obstacles such as, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.
7. Distributed (in house) Antenna System (DAS): An Emergency Radio Communications System installed for Emergency Responder (or first responders and Government personnel) use while inside facility to maintain contact with each respective control point; refer to Section 27 53 19, DISTRIBUTED RADIO ANTENNA (WITHIN BUILDING) EQUIPMENT AND SYSTEMS.
8. DEMARC, Extended DMARC or ENTR: Service provider's main point of demarcation owned by LEC or service provider and establishes a physical point where service provider's responsibilities for service and maintenance end. This point is called NID, in data networks.
9. Effectively Grounded: Intentionally bonded to earth through connections of low impedance having current carrying capacity to prevent buildup of currents and voltages resulting in hazard to equipment or persons.
10. Electrical Supervision: Analyzing a system's function and components (i.e. cable breaks / shorts, inoperative stations, lights, LEDs and states of change, from primary to backup) on a 24/7/365 basis; provide aural and visual emergency notification signals to minimum two remote designated or accepted monitoring stations.
11. Electrostatic Interference (ESI) or Electrostatic Discharge Interference: Refer to EMI and RFI.
12. Emergency Call Systems: Wall units (in parking garages and stairwells) and pedestal mounts (in parking lots) typically provided with a strobe, camera and two-way audio communication functions. Additional units are typically provided in facility's emergency room, designated nurses stations, director's office, Disaster Control Center, SCC, ECC.
13. Project 25 (2014) (P25 (TIA-102 Series)): Set of standards for local, state and Federal public safety organizations and agencies digital LMR services. P25 is applicable to LMR

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- equipment authorized or licensed under the US Department of Commerce National Telecommunications and Information Administration or FCC rules and regulations and is a required standard capability for all LMR equipment and systems.
14. Grounding Electrode Conductor: (GEC) Conductor connected to earth grounding electrode.
  15. Grounding Electrode System: Electrodes through which an effective connection to earth is established, including supplementary, communications system grounding electrodes and GEC.
  16. Grounding Equalizer or Backbone Bonding Conductor (BBC): Conductor that interconnects elements of telecommunications grounding infrastructure.
  17. Head End (HE): Equipment, hardware and software, or a master facility at originating point in a communications system designed for centralized communications control, signal processing, and distribution that acts as a common point of connection between equipment and devices connected to a network of interconnected equipment, possessing greatest authority for allowing information to be exchanged, with whom other equipment is subordinate.
  18. Microducts: All forms of air blown fiber pathways.
  19. Ohm: A unit of resistive measurement.
  20. Received Signal Strength Indication (RSSI): A measurement of power present in a received RF signal.
  21. Service Provider Demarcation Point (SPDP): Not owned by LEC or service provider, but designated by Government as point within facility considered the DEMARC.
  22. Sound (SND): Changing air pressure to audible signals over given time span.
  23. System: Specific hardware, firmware, and software, functioning together as a unit, performing task for which it was designed.
  24. Telecommunications Bonding Backbone (TBB): Conductors of appropriate size (minimum 53.49 mm<sup>2</sup> [1/0 AWG]) stranded copper wire, that connect to Grounding Electrode System and route to telecommunications main grounding busbar (TMGB) and circulate to interconnect various TGBs and other locations shown on drawings.
  25. Voice over Internet Protocol (VoIP): A telephone system in which voice signals are converted to packets and transmitted over LAN network using Transmission Control Protocol (TCP)/Internet Protocol (IP). VA'S VoIP is not listed or coded for life and public safety, critical, emergency or other protection functions. When VoIP system or equipment is provided instead of PBX system or equipment, each TR (STR) and DEMARC requires increased AC power provided to compensate for loss of PBX's telephone instrument line power; and, to compensate for absence of PBX's UPS capability.
  26. Wide Area Network (WAN): A digital network that transcends localized LANs within a given geographic location. VA'S WAN/LAN is not nationally listed or coded for life and public safety, critical, emergency or other safety functions.

### 1.03 APPLICABLE PUBLICATIONS

- A. Applicability of Standards: Unless documents include more stringent requirements, applicable construction industry standards have same force and effect as if bound or copied directly into the documents to extent referenced. Such standards are made a part of these documents by reference.
  1. Each entity engaged in construction must be familiar with industry standards applicable to its construction activity.
  2. Obtain standards directly from publication source, where copies of standards are needed to perform a required construction activity.
- B. Government Codes, Standards and Executive Orders: Refer to <http://www.cfm.va.gov/TIL/cPro.asp>:
  1. Federal Communications Commission, (FCC) CFR, Title 47:

Part 15	Restrictions of use for Part 15 listed RF Equipment in Safety of Life
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	Emergency Functions and Equipment Locations
Part 47	Chapter A, Paragraphs 6.1-6.23, Access to Telecommunications Service, Telecommunications Equipment and Customer Premises Equipment
Part 58	Television Broadcast Service
Part 73	Radio and Television Broadcast Rules
Part 90	Rules and Regulations, Appendix C
Form 854	Antenna Structure Registration
Chapter XXIII	National Telecommunications and Information Administration (NTIA, P/O Commerce, Chapter XXIII) the 'Red Book' - Chapters 7, 8, & 9 compliments CFR, Title 47, FCC Part 15, RF Restriction of Use and Compliance in "Safety of Life" Functions & Locations

2. Telecommunications Standards and Specifications for Materials, Equipment and Construction:
  - a. RUS Bull 1751F-630 Design of Aerial Cable Plants
  - b. RUS Bull 1751F-640 Design of Buried Cable Plant, Physical Considerations
  - c. RUS Bull 1751F-643 Underground Plant Design
  - d. RUS Bull 1751F-815 Electrical Protection of Outside Plants,
  - e. RUS Bull 1753F-201 Acceptance Tests of Telecommunications Plants (PC-4)
  - f. RUS Bull 1753F-401 Splicing Copper and Fiber Optic Cables (PC-2)
  - g. RUS Bull 345-50 Trunk Carrier Systems (PE-60)
  - h. RUS Bull 345-65 Shield Bonding Connectors (PE-65)
  - i. RUS Bull 345-72 Filled Splice Closures (PE-74)
  - j. RUS Bull 345-83 Gas Tube Surge Arrestors (PE-80)
3. US Department of Commerce/National Institute of Standards Technology,(NIST):
  - a. FIPS PUB 1-1 Telecommunications Information Exchange
  - b. FIPS PUB 100/1 Interface between Data Terminal Equipment (DTE) Circuit Terminating Equipment for operation with Packet Switched Networks, or Between Two DTEs, by Dedicated Circuit
  - c. FIPS PUB 140/2 Telecommunications Information Security Algorithms
  - d. FIPS PUB 143 General Purpose 37 Position Interface between DTE and Data Circuit Terminating Equipment
  - e. FIPS 160/2 Electronic Data Interchange (EDI),
  - f. FIPS 175 Federal Building Standard for Telecommunications Pathway and Spaces
  - g. FIPS 191 Guideline for the Analysis of Local Area Network Security
  - h. FIPS 197 Advanced Encryption Standard (AES)
  - i. FIPS 199 Standards for Security Categorization of Federal Information and Information Systems
4. US Department of Defense, (DoD):
  - a. MIL-STD-188-110 Interoperability and Performance Standards for Data Modems
  - b. MIL-STD-188-114 Electrical Characteristics of Digital Interface Circuits
  - c. MIL-STD-188-115 Communications Timing and Synchronizations Subsystems
  - d. MIL-C-28883 Advanced Narrowband Digital Voice Terminals
  - e. MIL-C-39012/21 Connectors, Receptacle, Electrical, Coaxial, Radio Frequency, (Series BNC (Uncabled), Socket Contact, Jam Nut Mounted, Class 2)
5. US Department of Health and Human Services:
  - a. The Health Insurance Portability and Accountability Act of 1996 (HIPAA) Privacy, Security and Breach Notification Rules
6. US Department of Justice:



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- a. 2010 Americans with Disabilities Act Standards for Accessible Design (ADAAD).
7. US Department of Labor, (DoL) - Public Law 426-62 – CFR, Title 29, Part 1910, Chapter XVII - Occupational Safety and Health Administration (OSHA), Occupational Safety and Health Standards):
  - a. Subpart 7 - Approved NRTLs; obtain a copy at <https://www.osha.gov/dts/otpca/nrtl/nrtllist.html>
  - b. Subpart 35 - Compliance with NFPA 101, Life Safety Code
  - c. Subpart 36 - Design and Construction Requirements for Exit Routes
  - d. Subpart 268 - Telecommunications
  - e. Subpart 305 - Wiring Methods, Components, and Equipment for General Use
  - f. Subpart 508 - Americans with Disabilities Act Accessibility Guidelines; technical requirement for accessibility to buildings and facilities by individuals with disabilities
8. US Department of Transportation, (DoT):
  - a. Public Law 85-625, CFR, Title 49, Part 1, Subpart C – Federal Aviation Administration (FAA):AC 110/460-ID & AC 707 / 460-2E – Advisory Circulars Standards for Construction of Antenna Towers, and 7450 and 7460-2 – Antenna Construction Registration Forms.
9. US Department of Veterans Affairs (VA): Office of Telecommunications (OI&T), MP-6, PART VIII, TELECOMMUNICATIONS, CHAPTER 5, AUDIO, RADIO AND TELEVISION (and COMSEC) COMMUNICATIONS SYSTEMS: Spectrum Management and COMSEC Service (SMCS), AHJ for:
  - a. CoG, “Continuance of Government” communications guidelines and compliance.
  - b. COMSEC, “VA wide coordination and control of security classified communication assets.”
  - c. COOP, “Continuance of Operations” emergency communications guidelines and compliance.
  - d. FAA, FCC, and US Department of Commerce National Telecommunications and Information Administration, “VA wide RF Co-ordination, Compliance and Licensing.”
  - e. Handbook 6100 – Telecommunications: Cyber and Information Security Office of Cyber and Information Security, and Handbook 6500 – Information Security Program.
  - f. Low Voltage Special Communications Systems “Design, Engineering, Construction Contract Specifications and Drawings Conformity, Proof of Performance Testing, VA Compliance and Life Safety Certifications for CFM and VA Facility Low Voltage Special Communications Projects (except Fire Alarm, Telephone and Data Systems).”
  - g. SATCOM, “Satellite Communications” guidelines and compliance, and Security and Law Enforcement Systems – “Coordinates the Design, Engineering, Construction Contract Specifications and Drawings Conformity, Proof of Performance Testing, VA Compliance, DEA and Public Safety Certification(s) for CFM and VA Facility Security Low Voltage Special Communications and Physical Security Projects.
  - h. VHA’s National Center for Patient Safety – Veterans Health Administration (VHA) Warning System, Failure of Medical Alarm Systems using Paging Technology to Notify Clinical Staff, July 2004.
  - i. VA’s CEOSH, concurrence with warning identified in VA Directive 7700.
  - j. Wireless and Handheld Devices, “Guidelines and Compliance,”
  - k. Office of Security and Law Enforcement: VA Directive 0730 and Health Special Presidential Directive (HSPD)-12.
- C. NRTL Standards: Refer to <https://www.osha.gov/laws-regs/regulations/standardnumber/1926>
  1. Canadian Standards Association (CSA); same tests as presented by UL
  2. Communications Certifications Laboratory (CEL); same tests as presented by UL.
  3. Intertek Testing Services NA, Inc., (ITSNA), formerly Edison Testing Laboratory (ETL) same tests as presented by UL).
  4. Underwriters Laboratory (UL):

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- a. 1-2005 Flexible Metal Conduit
- b. 5-2011 Surface Metal Raceway and Fittings
- c. 6-2007 Rigid Metal Conduit
- d. 44-010 Thermoset-Insulated Wires and Cables
- e. 50-1995 Enclosures for Electrical Equipment
- f. 65-2010 Wired Cabinets
- g. 83-2008 Thermoplastic-Insulated Wires and Cables
- h. 96-2005 Lightning Protection Components
- i. 96A-2007 Installation Requirements for Lightning Protection Systems
- j. 360-2013 Liquid-Tight Flexible Steel Conduit
- k. 44-2008 Communications Cables
- l. 457-2013 Grounding and Bonding Equipment
- m. 486A-486B-2013 Wire Connectors
- n. 486-2013 Splicing Wire Connectors
- o. 486D-2005 Sealed Wire Connector Systems
- p. 486E-2009 Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
- q. 493-2007 Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable
- r. 497/497A/497B/497C  
497D/497E Protectors for Paired Conductors/Communications Circuits/Data Communications and Fire Alarm Circuits/coaxial circuits/voltage protections/Antenna Lead In
- s. 510-2005 Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
- t. 514A-2013 Metallic Outlet Boxes
- u. 514B-2012 Fittings for Cable and Conduit
- v. 514C-1996 Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
- w. 651-2011 Schedule 40 and 80 Rigid PVC Conduit
- x. 651A-2011 Type EB and A Rigid PVC Conduit and HDPE Conduit
- y. 797-2007 Electrical Metallic Tubing
- z. 884-2011 Underfloor Raceways and Fittings
- aa. 1069-2007 Hospital Signaling and Nurse Call Equipment
- bb. 1242-2006 Intermediate Metal Conduit
- cc. 1449-2006 Standard for Transient Voltage Surge Suppressors
- dd. 1479-2003 Fire Tests of Through-Penetration Fire Stops
- ee. 1480-2003 Speaker Standards for Fire Alarm, Emergency, Commercial and Professional use
- ff. 1666-2007 Standard for Wire/Cable Vertical (Riser) Tray Flame Tests
- gg. 1685-2007 Vertical Tray Fire Protection and Smoke Release Test for Electrical and Fiber Optic Cables
- hh. 1861-2012 Communication Circuit Accessories
- ii. 1863-2013 Standard for Safety, communications Circuits Accessories
- jj. 1865-2007 Standard for Safety for Vertical-Tray Fire Protection and Smoke-Release Test for Electrical and Optical-Fiber Cables
- kk. 2024-2011 Standard for Optical Fiber Raceways
- ll. 2024-2014 Standard for Cable Routing Assemblies and Communications Raceways
- mm. 2196-2001 Standard for Test of Fire Resistive Cable
- nn. 60950-1 ed. 2-2014 Information Technology Equipment Safety

D. Industry Standards:

- 1. Advanced Television Systems Committee (ATSC):
  - a. ATSC Digital Television Standard, Part 1, Digital Television System: 2013

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- b. ATSC Digital Television Standard, Part 2, RF/Transmission System Characteristics: 2011
- c. ATSC Digital Television Standard, Part 3, Service Multiplex and Transport System Characteristics: 2013
- d. ATSC Digital Television Standard, Part 4, MPEG-2 Video System Characteristics: 2009
- e. ATSC Digital Television Standard, Part 5, AC-3 Audio System Characteristics: 2014
- f. ATSC digital Television Standard, Part 6, Enhanced AC-3 Audio System Characteristics: 2014
2. American Institute of Architects (AIA): 2006 Guidelines for Design & Construction of Health Care Facilities.
3. American Society of Mechanical Engineers (ASME):
  - a. 17.4 (2009) Guide for Emergency Personnel
4. American Society for Testing and Materials (ASTM):
  - a. B1 (2001) Standard Specification for Hard-Drawn Copper Wire
  - b. B8 (2004) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
  - c. D1557 (2012) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort 56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)
  - d. D2301 (2004) Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape
  - e. B258-02 (2008) Standard Specification for Standard Nominal Diameters and Cross-Sectional Areas of AWG Sizes of Solid Round Wires Used as Electrical Conductors
  - f. D709-01 (2007) Standard Specification for Laminated Thermosetting Materials
  - g. D4566 (2008) Standard Test Methods for Electrical Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable
5. American Telephone and Telegraph Corporation (AT&T) - Obtain following AT&T Publications at <https://ebiznet.sbc.com/sbcnebs/>
  - a. ATT-TP-76200 (2013) Network Equipment and Power Grounding, Environmental, and Physical Design Requirements
  - b. ATT-TP-76305 (2013) Merged AT&T Affiliate Companies Installation Requirements
  - c. ATT-TP-76306 (2013) Common Systems Cable and Wire Installation and Removal Requirements - Cable Racks and Raceways
  - d. ATT-TP-76306 (2009) Electrostatic Discharge Control
  - e. ATT-TP-76400 (2012) Detail Engineering Requirements
  - f. ATT-TP-76402 (2013) AT&T Raised Access Floor Engineering and Installation Requirements
  - g. ATT-TP-76405 (2011) Technical Requirements for Supplemental Cooling Systems in Network Equipment Environments
  - h. ATT-TP-76416 (2011) Grounding and Bonding Requirements for Network Facilities
  - i. ATT-TP-76440 (2005) Ethernet Specification
  - j. ATT-TP-76450 (2013) Common Systems Equipment Interconnection Standards for AT&T Network Equipment Spaces
  - k. ATT-TP-76461 (2008) Fiber Optic Cleaning
  - l. ATT-TP-76900 (2010) AT&T Installation Testing Requirement
  - m. ATT-TP-76911 (1999) AT&T LEC Technical Publication Notice
6. British Standards Institution (BSI):
  - a. BS EN 50109-2 Hand Crimping Tools - Tools for The Crimp Termination of Electric Cables and Wires for Low Frequency and Radio Frequency Applications – All Parts & Sections. October 1997
7. Building Industry Consulting Service International (BICSI):
  - a. ANSI/BICSI 002-2011 Data Center Design and Implementation Best Practices

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- b. ANSI/BICSI 004-2012 Information Technology Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities
- c. ANSI/NECA/BICSI 568-2006 Standard for Installing Commercial Building Telecommunications Cabling
- d. NECA/BICSI 607-2011 Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
- e. ANSI/BICSI 005-2013 Electronic Safety and Security (ESS) System Design and Implementation Best Practices
8. Electronic Components Assemblies and Materials Association, (ECA).
  - a. ECA EIA/RS-270 (1973) Tools, Crimping, Solderless Wiring Devices – Recommended Procedures for User Certification
  - b. EIA/ECA 310-E (2005) Cabinets, and Associated Equipment
9. Facility Guidelines Institute: 2010 Guidelines for Design and Construction of Health Care Facilities.
10. Insulated Cable Engineers Association (ICEA):
  - a. ANSI/ICEA S-80-576-2002  
Category 1 & 2 Individually Unshielded Twisted-Pair Indoor Cables for Use in Communications Wiring Systems
  - b. ANSI/ICEA S-84-608-2010  
Telecommunications Cable, Filled Polyolefin Insulated Copper Conductor, S-87-640(2011) Optical Fiber Outside Plant Communications Cable
  - c. ANSI/ICEA S-90-661-2012  
Category 3, 5, & 5e Individually Unshielded Twisted-Pair Indoor Cable for Use in General Purpose and LAN Communication Wiring Systems
  - d. S-98-688 (2012) Broadband Twisted Pair Cable Aircore, Polyolefin Insulated, Copper Conductors
  - e. S-99-689 (2012) Broadband Twisted Pair Cable Filled, Polyolefin Insulated, Copper Conductors
  - f. ICEA S-102-700 (2004)  
Category 6 Individually Unshielded Twisted Pair Indoor Cables (With or Without an Overall Shield) for use in Communications Wiring Systems Technical Requirements
11. Institute of Electrical and Electronics Engineers (IEEE):
  - a. ISSN 0739-5175 March-April 2008 Engineering in Medicine and Biology Magazine, IEEE (Volume: 27, Issue:2) Medical Grade-Mission Critical-Wireless Networks
  - b. IEEE C2-2012 National Electrical Safety Code (NESC)
  - c. C62.41.2-2002/Cor 1-2012 IEEE  
Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits 4)
  - d. C62.45-2002 IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits
  - e. 81-2012 IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System
  - f. 100-1992 IEEE the New IEEE Standards Dictionary of Electrical and Electronics Terms
  - g. 602-2007 IEEE Recommended Practice for Electric Systems in Health Care Facilities
  - h. 1100-2005 IEEE Recommended Practice for Powering and Grounding Electronic Equipment
12. International Code Council:
  - a. AC193 (2014) Mechanical Anchors in Concrete Elements
13. International Organization for Standardization (ISO):
  - a. ISO/TR 21730 (2007) Use of Mobile Wireless Communication and Computing Technology in Healthcare Facilities - Recommendations for Electromagnetic Compatibility (Management of Unintentional Electromagnetic Interference) with

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Medical Devices

14. National Electrical Manufacturers Association (NEMA):
  - a. NEMA 250 (2008) Enclosures for Electrical Equipment (1,000V Maximum)
  - b. ANSI C62.61 (1993) American National Standard for Gas Tube Surge Arresters on Wire Line Telephone Circuits
  - c. ANSI/NEMA FB 1 (2012) Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing EMT) and Cable
  - d. ANSI/NEMA OS 1 (2009) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
  - e. NEMA SB 19 (R2007) NEMA Installation Guide for Nurse Call Systems
  - f. TC 3 (2004) Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing
  - g. NEMA VE 2 (2006) Cable Tray Installation Guidelines
15. National Fire Protection Association (NFPA):
  - a. 70E-2015 Standard for Electrical Safety in the Workplace
  - b. 70-2014 National Electrical Code (NEC)
  - c. 70-2013 National Fire Alarm Code
  - d. 75-2013 Standard for the Fire Protection of Information Technological Equipment
  - e. 76-2012 Recommended Practice for the Fire Protection of Telecommunications Facilities
  - f. 77-2014 Recommended Practice on Static Electricity
  - g. 90A-2015 Standard for the Installation of Air Conditioning and Ventilating Systems
  - h. 99-2015 Health Care Facilities Code
  - i. 101-2015 Life Safety Code
  - j. 241 Safeguarding construction, alternation and Demolition Operations
  - k. 255-2006 Standard Method of Test of Surface Burning Characteristics of Building Materials
  - l. 262-2011 Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces
  - m. 780-2014 Standard for the Installation of Lightning Protection Systems
  - n. 1221-2013 Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems
  - o. 500-2015 Building Construction and Safety Code
16. Society for Protective Coatings (SSPC):
  - a. SSPC SP 6/NACE No.3 (2007) Commercial Blast Cleaning
17. Society of Cable Telecommunications Engineers (SCTE):
  - a. ANSI/SCTE 15 2006 Specification for Trunk, Feeder and Distribution Coaxial Cable
18. Telecommunications Industry Association (TIA):
  - a. TIA-120 Series Telecommunications Land Mobile communications (APCO/Project 25) (January 2014)
  - b. TIA TSB-140 Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems (2004)
  - c. TIA-155 Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T (2010)
  - d. TIA TSB -162-A Telecommunications Cabling Guidelines for Wireless Access Points (2013)
  - e. TIA-222-G Structural Standard for Antenna Supporting Structures and Antennas (2014)
  - f. TIA/EIA-413-B Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits (2012)

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- g. TIA-455-C General Requirements for Standard Test Procedures for Optical Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and other Fiber Optic Components (August 2014)
- h. TIA-455-53-A FOTP-53 Attenuation by Substitution Measurements for Multimode Graded-Index Optical Fibers in Fiber Assemblies (Long Length) (September 2001)
- i. TIA-455-61-A FOTP-61 Measurement of Fiber of Cable Attenuation Using an OTDR (July 2003)
- j. TIA-472D000-B Fiber Optic Communications Cable for Outside Plant Use (July 2007)
- k. ANSI/TIA-492-B 62.5- $\mu$  Core Diameter/125-um Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers (November 2009)
- l. ANSI/TIA-492AAAB-A 50-um Core Diameter/125-um Cladding Diameter Class IA Graded-Index Multimode Optically Optimized American Standard Fibers (November 2009)
- m. TIA-492CAAA Detail Specification for Class IVa Dispersion- Unshifted Single-Mode Optical Fibers (September 2002)
- n. TIA-492E000 Sectional Specification for Class IVd Nonzero- Dispersion Single-Mode Optical Fibers for the 1,550 nm Window (September 2002)
- o. TIA-526-7-B Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant – OFSTP-7 (December 2008)
- p. TIA-526.14-A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant – SFSTP-14 (August 1998)
- q. TIA-568 Revision/Edition: C Commercial Building Telecommunications Cabling Standard Set: (TIA-568-C.0-2 Generic Telecommunications Cabling for Customer Premises (2012), TIA-568-C.1-1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements (2012), TIA-568-C.2 Commercial Building Telecommunications Cabling Standard—Part 2: Balanced Twisted Pair Cabling Components (2009), TIA-568-C.3-1 Optical Fiber Cabling Components Standard, (2011) AND TIA-568-C.4 Broadband Coaxial Cabling and Components Standard (2011) with addendums and errata's
- r. TIA-569 Revision/Edition C Telecommunications Pathways and Spaces (March 2013)
- s. TIA-574 Position Non-Synchronous Interface between Data Terminal equipment and Data Circuit Terminating Equipment Employing Serial Binary Interchange (May 2003)
- t. TIA/EIA-590-A Standard for Physical Location and Protection of Below Ground Fiber Optic Cable Plant (July 2001)
- u. TIA-598-D Optical Fiber Cable Color Coding (January 2005)
- v. TIA-604-10-B Fiber Optic Connector Intermateability Standard (August 2008)
- w. ANSI/TIA-606-B Administration Standard for Telecommunications Infrastructure (2012)
- x. TIA-607-B Generic Telecommunications Bonding and Grounding (Earthing) For Customer Premises (January 2013)
- y. TIA-613 High Speed Serial Interface for Data Terminal Equipment and Data Circuit Terminal Equipment (September 2005)
- z. ANSI/TIA-758-B Customer-owned Outside Plant Telecommunications Infrastructure Standard (April 2012)
- aa. ANSI/TIA-854 A Full Duplex Ethernet Specification for 1000 Mb/s (1000BASE-TX) Operating over Category 6 Balanced Twisted-Pair Cabling (2001)
- bb. ANSI/TIA-362-A Building Automation Systems Cabling Standard (April 2011)
- cc. TIA-942-A Telecommunications Infrastructure Standard for Data Centers (March 2014)

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- dd. TIA-1152 Requirements for Field Testing Instruments and Measurements for Balanced Twisted Pair Cabling (September 2009)
- ee. TIA-1179 Healthcare Facility Telecommunications Infrastructure Standard (July 2010)

**1.04 SINGULAR NUMBER**

- A. Where any device or part of equipment is referred in singular number (such as " rack"), reference applies to as many such devices as are required to complete installation.

**1.05 RELATED WORK**

- A. Specification Order of Precedence: FAR Clause 52.236-21, VAAR Clause 852.236-71.
  - 1. Field Cutting and Patching: Section 09 91 00, PAINTING.
  - 2. Additional submittal requirements: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
  - 3. Availability and source of references and standards specified in applicable publications: Section 01 42 19, REFERENCE STANDARDS.
  - 4. Control of environmental pollution and damage for air, water, and land resources: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
  - 5. Requirements for non-hazardous building construction and demolition waste: Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.
  - 6. General requirements and procedures to comply with various federal mandates and U.S. Department of Veterans Affairs (VA) policies for sustainable design: Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS.
  - 7. Closures of openings in walls, floors, and roof decks against penetration of flame, heat, and smoke or gases in fire resistant rated construction: Section 07 84 00, FIRESTOPPING.
  - 8. Sealant and caulking materials and their application: Section 07 92 00, JOINT SEALANTS.
  - 9. General electrical requirements that are common to more than one section of Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
  - 10. Electrical conductors and cables in electrical systems rated 600 V and below: Section 26 05 21, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
  - 11. Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
  - 12. Conduit and boxes: Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS.
    - a. Wiring devices: Section 26 27 26, WIRING DEVICES.
  - 13. Underground ducts, raceways, precast manholes and pull boxes: Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION.
  - 14. Lightning protection: Section 26 41 00, FACILITY LIGHTNING PROTECTION.
  - 15. General requirements common to more than one section in Division 28: Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
  - 16. Conductors and cables for electronic safety and security systems: Section 28 05 13, CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY.
  - 17. Low impedance path to ground for electronic safety and security system ground fault currents: Section 28 05 26, GROUNDING AND BONDING FOR SECURITY SYSTEMS.
  - 18. Conduits and partitioned telecommunications raceways for Electronic Safety and Security systems: Section 28 05 28.33, CONDUITS AND BACK BOXES FOR ELECTRONIC SAFETY AND SECURITY.
  - 19. Physical Access Control System field-installed controllers connected by data transmission network: Section 28 13 00, PHYSICAL ACCESS DETECTION.
  - 20. Detection and screening systems: Section 28 13 53, SECURITY ACCESS DETECTION.

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21. Intrusion sensors and detection devices, and communication links to perform monitoring, alarm, and control functions: Section 28 16 11, INTRUSION DETECTION EQUIPMENT AND SYSTEMS.
22. Video surveillance system cameras, data transmission wiring, and control stations with associated equipment: Section 28 23 00, VIDEO SURVEILLANCE EQUIPMENT AND SYSTEMS.
23. Duress-panic alarms, emergency phones or call boxes, intercom systems, data transmission wiring and associated equipment: Section 28 26 00, ELECTRONIC PERSONAL PROTECTION EQUIPMENT AND SYSTEMS.
24. Alarm initiating devices, alarm notification appliances, control units, fire safety control devices, annunciators, power supplies, and wiring: Section 28 31 00, FIRE DETECTION AND ALARM.
25. Emergency Call telephones, intercom systems, with blue strobe light and equipment: Section 28 52 31, SECURITY EMERGENCY CALL/DURESS ALARM/COMMUNICATIONS SYSTEM AND EQUIPMENT.

#### **1.06 ADMINISTRATIVE REQUIREMENTS**

- A. Assign a single communications project manager to serve as point of contact for Government, contractor, and design professional.
- B. Be proactive in scheduling work.
  1. Use of premises is restricted at times directed by COR.
  2. Movement of materials: Unload materials and equipment delivered to site. Pay costs for rigging, hoisting, lowering and moving equipment on and around site, in building or on roof.
  3. Coordinate installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
  4. Sequence, coordinate, and integrate installations of materials and equipment for efficient flow of Work. Plan for large equipment requiring positioning prior to closing in building.
  5. Coordinate connection of materials, equipment, and systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies; provide required connection for each service.
  6. Initiate and maintain discussion regarding schedule for ceiling construction and install cables to meet that schedule.
- C. Contact the Office of Telecommunications, Special Communications Team (005OP2H3) (202)461-5310 to have a Government-accepted Telecommunications COR assigned to project for telecommunications review, equipment and system approval and coordination with other VA personnel.
- D. Communications Project Manager Responsibilities:
  1. Assume responsibility for overall telecommunications system integration and coordination of work among trades, subcontractors, and authorized system installers.
  2. Coordinate with related work indicated on drawings or specified.
  3. Manage work related to telecommunications system installation in a manner approved by manufacturer.

#### **1.07 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Provide parts list including quantity of spare parts.
- C. Provide manufacturer product information. Government reserves the right to require a list of installations where products have been in operation.
- D. Provide Source Quality Control Submittal:



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1. Submit written certification from OEM indicating that proposed supervisor of installation and proposed provider of warranty maintenance are authorized representatives of OEM. Include individual's legal name, contact information and OEM credentials in certification.
  2. Submit written certification from OEM that wiring and connection diagrams meet Government Life Safety Guidelines, NFPA, NEC, NRTL, these specifications, and Joint Commission requirements and instructions, requirements, recommendations, and guidance set forth by OEM for the proper performance of system.
  3. Pre-acceptance Certification: Certification in accordance with procedure outlined in Section 01 00 00, GENERAL REQUIREMENTS and specific Division 27 qualification documentation.
- E. Installer Qualifications: Submit three installations of similar size and complexity furnished and installed by installer; include:
1. Installation location and name.
  2. Owner's name and contact information including, address, telephone and email.
  3. Date of project start and date of final acceptance.
  4. System project number.
  5. Three paragraph description of each system related to this project; include function, operation, and installation.
- F. Provide delegated design submittals (e.g. seismic support design).
- G. Submittals are required for all equipment anchors and supports. Include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion,) associated with equipment or conduit. Anchors and supports to resist seismic load based on seismic design categories per section 4.0 of VA seismic design requirements H-18-8 dated August, 2013.
- H. Test Equipment List:
1. Supply test equipment of accuracy better than parameters to be tested.
  2. Submit test equipment list including make and model number:
    - a. ANSI/TIA-1152 Level IIIe // IV// twisted pair cabling test instrument.
    - b. Fiber optic insertion loss power meter with light source.
    - c. Optical time domain reflectometer (OTDR).
    - d. Volt-Ohm meter.
    - e. Digital camera.
    - f. Bit Error Test Set (BERT).
    - g. Signal level meter.
    - h. Time domain reflectometer (TDR) with strip chart recorder (Data and Optical Measuring)
    - i. Spectrum analyzer.
    - j. Color video monitor with audio capability.
    - k. Video waveform monitor.
    - l. Video vector scope.
    - m. 100 MHz oscilloscope with video adapters.
  3. Supply only test equipment with a calibration tag from Government-accepted calibration service dated not more than 12 months prior to test.
  4. Provide sample test and evaluation reports.
- I. Submittal Drawings:
1. Telecommunications Space Plans/Elevations: Provide enlarged floor plans of telecommunication spaces indicating layout of equipment and devices, including receptacles and grounding provisions. Submit detailed plan views and elevations of telecommunication spaces showing racks, termination blocks, and cable paths. Include following rooms:
    - a. Telecommunications rooms.

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- b. Building Entrance Facility/Demarcation rooms.
- c. Server rooms/Data Center.
- d. Equipment rooms.
- e. Antenna Head End rooms.
- 2. Logical Drawings: Provide logical riser or schematic drawings for all systems.
  - a. Provide riser diagrams systems and interconnection drawings for equipment assemblies; show termination points and identify wiring connections.
- 3. Access Panel Schedule on Submittal Drawings: Coordinate and prepare a location, size, and function schedule of access panels required to fully service equipment.
- J. Provide sustainable design submittals.
- K. Furnish electronic certified test reports to COR prior to final inspection and not more than 90 days after completion of tests.

**1.08 CLOSEOUT SUBMITTALS**

- A. Provide following closeout submittals prior to project closeout date:
  - 1. Warranty certificate.
  - 2. Evidence of compliance with requirements such as low voltage certificate of inspection.
  - 3. Project record documents.
  - 4. Instruction manuals and software that are a part of system.
- B. Maintenance and Operation Manuals: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
  - 1. Prepare a manual for each system and equipment specified.
  - 2. Furnish on portable storage drive in PDF format or equivalent accepted by COR.
  - 3. Furnish complete manual as specified in specification section, fifteen days prior to performance of systems or equipment test.
  - 4. Furnish remaining manuals prior to final completion.
  - 5. Identify storage drive "MAINTENANCE AND OPERATION MANUAL" and system name.
  - 6. Include name, contact information and emergency service numbers of each subcontractor installing system or equipment and local representatives for system or equipment.
  - 7. Provide a Table of Contents and assemble files to conform to Table of Contents.
  - 8. Operation and Maintenance Data includes:
    - a. Approved shop drawing for each item of equipment.
    - b. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of equipment.
    - c. A control sequence describing start-up, operation, and shutdown.
    - d. Description of function of each principal item of equipment.
    - e. Installation and maintenance instructions.
    - f. Safety precautions.
    - g. Diagrams and illustrations.
    - h. Test Results and testing methods.
    - i. Performance data.
    - j. Pictorial "exploded" parts list with part numbers. Emphasis to be placed on use of special tools and instruments. Indicate sources of supply, recommended spare parts, and name of servicing organization.
    - k. Warranty documentation indicating end date and equipment protected under warranty.
    - l. Appendix; list qualified permanent servicing organizations for support of equipment, including addresses and certified personnel qualifications.
- C. Record Wiring Diagrams:
  - 1. Red Line Drawings: Keep one E size 91.44 cm x 121.92 cm (36 inches x 48 inches) set of floor plans, on site during work hours, showing installation progress marked and backbone cable labels noted. Make these drawings available for examination during construction

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- meetings or field inspections.
2. General Drawing Specifications: Detail and elevation drawings to be D size 61 cm x 91.44 cm (24 inches x 36 inches) with a minimum scale of 0.635 cm = 30.48 cm (1/4 inch = 12 inches). ER, TR and other enlarged detail floor plan drawings to be D size 61 cm x 91.44 cm (24" x 36") with a minimum scale of 0.635 cm = 30.48 cm (1/4 inch = 12 inches). Building composite floor plan drawings to be D size 61 cm x 91.44 cm (24 inches x 36 inches) with a minimum scale of 3.175 mm = 30.48 cm (1/8 inch = 1' 0 inch).
  3. Building Composite Floor Plans: Provide building floor plans showing work area outlet locations and configuration, types of jacks, distance for each cable, and cable routing locations.
  4. Floor plans to include:
    - a. Final room numbers and actual backbone cabling and pathway locations and labeling.
    - b. Inputs and outputs of equipment identified according to labels installed on cables and equipment
    - c. Device locations with labels.
    - d. Conduit.
    - e. Head-end equipment.
    - f. Wiring diagram.
    - g. Labeling and administration documentation.
  5. Submit Record Wiring Diagrams within five business days after final cable testing.
  6. Deliver Record Wiring Diagrams as CAD files in .dwg formats.
  7. Deliver four complete sets of electronic record wiring diagrams to COR on portable storage drive.
- D. Service Qualifications: Submit name and contact information of service organizations providing service to this installation within eight hours of receipt of notification service is needed.

#### **1.09 MAINTENANCE MATERIAL SUBMITTALS**

- A. After approval and prior to installation, furnish COR with the following:
1. A 300 mm (12 inch) length of each type and size of wire and cable along with tag from coils of reels from which samples were taken.
  2. One coupling, bushing and termination fitting for each type of conduit.
  3. Samples of each hanger, clamp and supports for conduit and pathways.
  4. Duct sealing compound.

#### **1.10 QUALITY ASSURANCE**

- A. Manufacturer's Qualifications: Manufacturer must produce, as a principal product, the equipment and material specified for this project, and have manufactured item for at least three years.
- B. Product and System Qualification:
1. OEM must have three installations of equipment submitted presently in operation of similar size and type as this project, that have continuously operated for a minimum of three years.
  2. Government reserves the right to require a list of installations where products have been in operation before approval.
  3. Authorized representative of OEM must be responsible for design, satisfactory operation of installed system, and certification.
- C. Trade Contractor Qualifications: Trade contractor must have completed three or more installations of similar systems of comparable size and complexity with regards to coordinating, engineering, testing, certifying, supervising, training, and documentation. Identify these installations as a part of submittal.
- D. System Supplier Qualifications: System supplier must be authorized by OEM to warranty installed equipment.

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- E. Telecommunications technicians assigned to system must be trained, and certified by OEM on installation and testing of system; provide written evidence of current OEM certifications for installers.
- F. Manufactured Products:
  - 1. Comply with FAR clause 52.236-5 for material and workmanship.
  - 2. When more than one unit of same class of equipment is required, units must be product of a single manufacturer.
  - 3. Equipment Assemblies and Components:
    - a. Components of an assembled unit need not be products of same manufacturer.
    - b. Manufacturers of equipment assemblies, which include components made by others, to assume complete responsibility for final assembled unit.
    - c. Provide compatible components for assembly and intended service.
    - d. Constituent parts which are similar must be product of a single manufacturer.
  - 4. Identify factory wiring on equipment being furnished and on wiring diagrams.
- G. Testing Agencies: Government reserves the option of witnessing factory tests. Notify COR minimum 15 working days prior to manufacturer performing the factory tests.
  - 1. When equipment fails to meet factory test and re-inspection is required, contractor is liable for additional expenses, including expenses of Government.

**1.11 DELIVERY, STORAGE, AND HANDLING**

- A. Delivery and Acceptance Requirements:
  - 1. Government's approval of submittals must be obtained for equipment and material before delivery to job site.
  - 2. Deliver and store materials to job site in OEM's original unopened containers, clearly labeled with OEM's name and equipment catalog numbers, model and serial identification numbers for COR to inventory cable, patch panels, and related equipment.
- B. Storage and Handling Requirements:
  - 1. Equipment and materials must be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:
    - a. Store and protect equipment in a manner that precludes damage or loss, including theft.
    - b. Protect painted surfaces with factory installed removable heavy kraft paper, sheet vinyl or equivalent.
    - c. Protect enclosures, equipment, controls, controllers, circuit protective devices, and other like items, against entry of foreign matter during installation; vacuum clean both inside and outside before testing and operating.
- C. Coordinate storage.

**1.12 FIELD CONDITIONS**

- A. Where variations from documents are requested in accordance with GENERAL CONDITIONS and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, connecting work and related components must include additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.
- B. A contract adjustment or additional time will not be granted because of field conditions pursuant to FAR 52.236-2 and FAR 52.236-3; a contract adjustment or additional time will not be granted for additional work required for complete and usable construction and systems pursuant to FAR 52.246-12.

**1.13 WARRANTY**

- A. Comply with FAR clause 52.246-21, except as follows:
  - 1. Warranty material and equipment to be free from defects, workmanship, and remain so for a period of one year for Emergency Systems from date of final acceptance of system by

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- Government; provide OEM's equipment warranty document to COR.
2. Government maintenance personnel must have ability to contact OEM for emergency maintenance and logistic assistance, remote diagnostic testing, and assistance in resolving technical problems at any time; contractor and OEM must provide this capability.

## **PART 2 PRODUCTS**

### **2.01 PERFORMANCE AND DESIGN CRITERIA**

- A. Provide communications spaces and pathways conforming to TIA 569, at a minimum.
- B. In cases of renovations in historic or otherwise restrictive buildings, where it has been determined as impossible to follow above stated guidelines, exceptions must not modify maximum distances set forth in TIA 568 and 569; and exceptions must not in any way effect performance of entire TIP system.
- C. Modification to administrative issues requires written approvals from COR with concurrence from SMCS 005OP2H3, OEM, contractor, and local authorities.

### **2.02 EQUIPMENT IDENTIFICATION**

- A. Provide laminated black phenolic resin with a white core nameplates with minimum 6 mm (1/4 inch) high engraved lettering.
- B. Nameplates furnished by manufacturer as standard catalog items, unless other method of identification is indicated.

### **2.03 UNDERGROUND WARNING TAPE**

- A. Underground Warning: Standard 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type; red with black letters imprinted with "CAUTION BURIED ELECTRIC LINE BELOW", orange with black letters imprinted with "CAUTION BURIED TELEPHONE LINE BELOW" or orange with black letters imprinted with "CAUTION BURIED FIBER OPTIC LINE BELOW", as applicable.

### **2.04 WIRE LUBRICATING COMPOUND**

- A. Provide non-hardening or forming adhesive coating cable lubricants suitable for cable jacket material and raceway.

### **2.05 FIREPROOFING TAPE**

- A. Provide flexible, conformable fabric tape of organic composition and coated one side with flame-retardant elastomer.
- B. Tape must be self-extinguishing and cannot support combustion; arc-proof and fireproof.
- C. Tape cannot deteriorate when subjected to water, gases, salt water, sewage, or fungus; and tape must be resistant to sunlight and ultraviolet light.
- D. Application must withstand a 200-ampere arc for minimum 30 seconds.
- E. Securing Tape: Glass cloth electrical tape minimum 0.18 mm (7 mils) thick and 19 mm (3/4 inch) wide.

### **2.06 UNDERGROUND CABLES**

- A. Provide buried closure suitable for enclosing a straight, butt, and branch splice in a container into which can be poured an encapsulating compound.
- B. Provide closure of adequate strength to protect splice and maintain cable shield electrical continuity in buried environment.
- C. Provide re-enterable encapsulating compound maintaining chemical stability of closure.
- D. Provide filled splice cases in accordance with RUS Bull 345-72.
- E. Provide gel filled cable meeting requirements of ICEA S-99-689 and //RUS 1755.390// //RUS 1755.890//.

- F. In Vault or Manhole:
  - 1. Provide underground closure suitable to house a straight, butt, and branch splice in a protective housing into which can be poured an encapsulating compound
  - 2. Closure must be suitable thermoplastic, thermo-set, or stainless steel material supplying structural strength to pass mechanical and electrical requirements in a vault or maintenance hole (manhole) environment.
- G. Re-Enterable Encapsulating Compound: Product maintaining chemical stability of closure.
- H. Provide gel-filled splice cases in accordance with RUS Bull 345-72.

## **2.07 AERIAL (ABOVEGROUND) ENCLOSURES**

- A. Provide aboveground enclosures constructed of //minimum 2.108 mm (14 gauge) steel // ultraviolet resistant PVC // and acceptable for // pole // stake // mounting in accordance with RUS 1755.
- B. Size enclosures and install marker.
- C. Secure covers to prevent unauthorized entry.
- D. Provide gel filled cable meeting requirements of //ICEA S-99-689// //ICEA S-98-688//, and RUS 1755.390; except, Figure 8 distribution wire suitable for aerial installation with:
  - 1. 26,700 N (6,000 pound); or
  - 2. 6,000 pound Class A galvanized steel; or
  - 3. 26,700 N (6,000 pound) aluminum-clad steel strand.

## **2.08 TEMPORARY TIP PATHS (OVERHEAD TRACKS, ROAD/PATH BRIDGES, ETC.)**

- A. Provide for copper, fiber optic, RF, coaxial and designated electronic system cables to maintain facility communications service during construction and install so as to not present a pedestrian and traffic (including construction) safety hazard.
- B. /TIP temporary cable installations are not required to meet industry standards; but each must be reviewed and accepted, in writing, by COR with concurrences from SMCS 005OP2H3, OI&T and facility safety officer, prior to installation.
  - 1. Be responsible for work associated with each temporary TIP path installation, required by system design and its removal when determined no longer necessary.
  - 2. Survey outside TIP locations usually encountered, including roads, driveways, marked paths, high traffic passageways or personnel walkways, and provide COR with a plan for temporary paths.

## **2.09 ACCESS PANELS**

- A. Panels: 304 mm x 304 mm (12 inches by 12 inches), or size allowed by location to provide optimum access to equipment for maintenance and service.
- B. Provide access panels and doors as required to allow service of materials and equipment that require inspection, replacement, repair or service.
- C. Provide access panels where items installed require access and are concealed in floor, wall, furred space or above ceiling; ceilings consisting of lay-in or removable splined tiles do not require access panels.
- D. Provide access panels with same fire rating classification as surface penetrated.

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Penetrations and Sleeves:
  - 1. Lay out penetration and sleeve openings in advance, to permit provision in work.
  - 2. Set sleeves in forms before concrete is poured.
  - 3. Set sleeves prior to installation of structure for passage of pipes, conduit, ducts, etc.

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4. Provide sleeves and packing materials at penetrations of foundations, walls, slabs, partitions, and floors.
  5. Make sleeves that penetrate outside walls, basement slabs, footings, and beams waterproof.
  6. Fill slots, sleeves and other openings in floors or walls if not used.
    - a. Fill spaces in openings after installation of conduit or cable.
    - b. Provide fill for floor penetrations to prevent passage of water, smoke, fire, and fumes.
    - c. Provide fire resistant fill in rated floors and walls, to prevent passage of air, smoke and fumes.
  7. Install sleeves through floors watertight and extend minimum 50.8 mm (2 inches) above floor surface.
  8. Match and set sleeves flush with adjoining floor, ceiling, and wall finishes where raceways passing through openings are exposed in finished rooms.
  9. Annular space between conduit and sleeve must be minimum 6 mm (1/4 inch).
    - a. Do not provide sleeves for slabs-on-grade, unless specified or indicated otherwise.
    - b. Comply with requirements for firestopping, for sleeves through rated fire walls and smoke partitions.
    - c. Do not support piping risers or conduit on sleeves.
    - d. Identify unused sleeves and slots for future installation.
    - e. Provide core drilling if walls are poured or otherwise constructed without sleeves and wall penetration is required; do not penetrate structural members.
- B. Core Drilling:
1. Avoid core drilling whenever possible.
  2. Coordinate openings with other trades and utilities and prevent damage to structural reinforcement.
  3. Investigate existing conditions in vicinity of required opening prior to coring, including an x-ray of floor if determined necessary by competent person or COR.
  4. Protect areas from damage.
- C. Verification of In-Place Conditions:
1. Verify location, use and status of all material, equipment, and utilities that are specified, indicated, or determined necessary for removal.
    - a. Verify materials, equipment, and utilities to be removed are inactive, not required, or in use after completion of project.
    - b. Replace with equivalent any material, equipment and utilities that were removed by contractor that are required to be left in place.
  2. Existing Utilities: Do not interrupt utilities serving facilities occupied by Government or others unless permitted under following conditions and then only after arranging to provide temporary utility services, according to requirements indicated:
    - a. Notify COR in writing at least 14 days in advance of proposed utility interruptions.
    - b. Do not proceed with utility interruptions without Government's written permission.
- D. Provide suspended platforms, strap hangers, brackets, shelves, stands or legs for floor, wall and ceiling mounting of equipment as required.
- E. Provide steel supports and hardware for installation of hangers, anchors, guides, and other support hardware.
- F. Obtain and analyze catalog data, weights, and other pertinent data required for coordination of equipment support provisions and installation.
- G. Verify site conditions and dimensions of equipment to ensure access for proper installation of equipment without disassembly that would void warranty.

### 3.02 INSTALLATION - GENERAL

- A. Coordinate systems, equipment, and materials installation with other building components.

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- B. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings.
- C. Conform to VAAR 852.236.91 arrangements indicated, recognizing that work may be shown in diagrammatic form or have been impracticable to detail all items because of variances in manufacturers' methods of achieving specified results.
- D. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed in both exposed and un-exposed spaces.
- E. Install equipment according to manufacturers' written instructions.
- F. Install wiring and cabling between equipment and related devices.
- G. Install cabling, wiring, and equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum interference of adjacent other installations.
- H. Provide access panel or doors where units are concealed behind finished surfaces.
- I. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for wiring, cabling, and equipment installations.
- J. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide maximum headroom and access for service and maintenance as possible.
- K. Install systems, materials, and equipment giving priority to systems required to be installed at a specified slope.
- L. Avoid interference with structure and with work or other trades, preserving adequate headroom and clearing doors and passageways to satisfaction of COR and code requirements.
- M. Install equipment and cabling to distribute equipment loads on building structural members provided for equipment support under other sections; install and support roof-mounted equipment on structural steel or roof curbs as appropriate.
- N. Provide supplementary or miscellaneous items, appurtenances, devices and materials for a complete installation.

### **3.03 EQUIPMENT INSTALLATION**

- A. Locate equipment as close as practical to locations shown on drawings.
- B. Note locations of equipment requiring access on record drawings.
- C. Access and Access Panels: Verify access panel locations and construction with COR.
- D. Inaccessible Equipment:
  - 1. Where Government determines that contractor has installed equipment not conveniently accessible for operation and maintenance, equipment must be removed and reinstalled as directed and without additional cost to Government.
  - 2. Refer to Section 27 11 00, TELECOMMUNICATIONS ROOM FITTINGS for communication equipment cabinet assembly.
  - 3. Refer to Section 27 11 00, TELECOMMUNICATIONS ROOM FITTINGS for equipment labeling.

### **3.04 EQUIPMENT IDENTIFICATION**

- A. Install an identification sign which clearly indicates information required for use and maintenance of equipment.
- B. Secure identification signs with screws.

### **3.05 CUTTING AND PATCHING**

- A. Perform cutting and patching according to contract general requirements and as follows:
  - 1. Remove samples of installed work as specified for testing.



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2. Perform cutting, fitting, and patching of equipment and materials required to uncover existing infrastructure in order to provide access for correction of improperly installed existing or new work.
  3. Remove and replace defective work.
  4. Remove and replace non-conforming work.
- B. Cut, remove, and legally dispose of selected equipment, components, and materials, including removal of material, equipment, devices, and other items indicated to be removed and items made obsolete by new work.
- C. Provide and maintain temporary partitions or dust barriers adequate to prevent spread of dust and dirt to adjacent areas.
- D. Protect adjacent installations during cutting and patching operations.
- E. Protect structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
- F. Patch finished surfaces and building components using new materials specified for original installation and experienced installers.

**3.06 FIELD QUALITY CONTROL**

- A. Provide work according to VAAR 852.236.91 and FAR clause 52.236-5.
- B. Provide minimum clearances and work required for compliance with NFPA 70, National Electrical Code (NEC), and manufacturers' instructions; comply with additional requirements indicated for access and clearances.
- C. Verify all field conditions and dimensions that affect selection and provision of materials and equipment, and provide any disassembly, reassembly, relocation, demolition, cutting and patching required to provide work specified or indicated, including relocation and reinstallation of existing wiring and equipment.
1. Protect facility, equipment, and wiring from damage.
- D. Submit written notice that:
1. Project has been inspected for compliance with documents.
  2. Work has been completed in accordance with documents.
- E. Non-Conforming Work: Conduct project acceptance inspections, final completion inspections, substantial completion inspections, and acceptance testing and demonstrations after verification of system operation and completeness by Contractor.
- F. For project acceptance inspections, final completion inspections, substantial completion inspections, and testing/demonstrations that require more than one site visit by COR or design professional to verify project compliance for same material or equipment, Government reserves right to obtain compensation from contractor to defray cost of additional site visits that result from project construction or testing deficiencies and incompleteness, incorrect information, or non-compliance with project provisions.
1. COR will notify contractor, of hourly rates and travel expenses for additional site visits, and will issue an invoice to Contractor for additional site visits.
  2. Contractor is not be eligible for extensions of project schedule or additional charges resulting from additional site visits that result from project construction or testing deficiencies/incompleteness, incorrect information, or non-compliance with Project provisions.
- G. Tests:
1. Interim inspection is required at approximately 50 percent of installation.
  2. Request inspection ten working days prior to interim inspection start date by notifying COR in writing; this inspection must verify equipment and system being provided adheres to installation, mechanical and technical requirements of construction documents.

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3. Inspection to be conducted by OEM and factory-certified contractor representative, and witnessed by COR, facility and SMCS 0050P2H3 representatives.
  4. Check each item of installed equipment to ensure appropriate NRTL listing labels and markings are fixed in place.
  5. Verify cabling terminations in DEMARC, MCR, TER, SCC, ECC, TRs and head end rooms, workstation locations and TCO adhere to color code for // T568B // T568A // pin assignments and cabling connections are in compliance with TIA standards.
  6. Visually confirm minimum Category 6 cable marking at TCOs, CCSs locations, patch cords and origination locations.
  7. Review entire communications circulating ground system, each TGB and grounding connection, grounding electrode and outside lightning protection system.
  8. Review cable tray, conduit and path/wire way installation practice.
  9. OEM and contractor to perform:
    - a. Fiber optical cable field inspection tests via attenuation measurements on factory reels; provide results along with OEM certification for factory reel tests.
    - b. Coaxial cable field inspection tests via attenuation measurements on factory reels; provide results along with OEM certification for factory reel tests.
    - c. Baseband cable field inspection tests via attenuation measurements on factory reels and provide results along with OEM certification for factory reel tests.
  10. Relocate failed cable reels to a secured location for inventory, as directed by COR, and then remove from project site within two working days; provide COR with written confirmation of defective cable reels removal from project site.
  11. Provide results of interim inspections to COR.
  12. If major or multiple deficiencies are discovered, additional interim inspections could be required until deficiencies are corrected, before permitting further system installation.
    - a. Additional inspections are scheduled at direction of COR.
    - b. Re-inspection of deficiencies noted during interim inspections, must be part of system's Final Acceptance Proof of Performance Test.
    - c. The interim inspection cannot affect the system's completion date unless directed by COR.
  13. Facility COR will ensure test documents become a part of system's official documentation package.
- H. Pretesting: Re-align, re-balance, sweep, re-adjust and clean entire system and leave system working for a "break-in" period, upon completing installation of system and prior to Final Acceptance Proof of Performance Test. System RF transmitting equipment must not be connected to keying or control lines during "break-in" period.
1. Pretesting Procedure:
    - a. Verify systems are fully operational and meet performance requirements, utilizing accepted test equipment and spectrum analyzer.
    - b. Pretest and verify system functions and performance requirements conform to construction documents and, that no unwanted physical, aural and electronic effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise are present.
  2. Measure and record signal, aural and control carrier levels of each DAS RF, voice and data channel, at each of the following minimum points in system:
    - a. Utility provider entrance.
    - b. Buried conduit duct locations.
    - c. Maintenance Holes (Manholes) and hand holes.
    - d. ENTR or DEMARC.
    - e. PBX interconnections.
    - f. MCR interconnections.
    - g. MCOR interconnections.
    - h. TER interconnections.
    - i. TOR interconnections.

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- j. Control room interconnections.
  - k. TR interconnections.
  - l. System interfaces in locations listed herein.
  - m. HE interconnections.
  - n. Antenna (outside and inside) interconnections.
  - o. System and lightning ground interconnections.
  - p. Communications circulating ground system.
  - q. UPS areas.
  - r. Emergency generator interconnections.
  - s. Each general floor areas.
  - t. Others as required by AHJ (SMCS 005OP2H3).
3. Provide recorded system pretest measurements and certification that the system is ready for formal acceptance test to COR.
- I. Acceptance Test:
1. Schedule an acceptance test date after system has been pretested, and pretest results and certification submitted to COR.
  2. Give COR fifteen working days written notice prior to date test is expected to begin; include expected duration of time for test in notification.
  3. Test in the presence of the following:
    - a. COR.
    - b. OEM representatives.
    - c. VACO:
      - 1) CFM representative.
      - 2) AHJ–SMCS 005OP2H3, (202)461-5310.
    - d. VISN–CIO, Network Officer and VISN representatives.
    - e. Facility:
      - 1) FMS Service Chief, Bio-Medical Engineering and facility representatives.
      - 2) OI&T Service Chief and OI&T representatives.
      - 3) Safety Officer, Police Chief and facility safety representatives.
    - f. Local Community Safety Personnel:
      - 1) Fire Marshal representative.
      - 2) Disaster Coordinator representative.
      - 3) EMS Representatives: Police, Sherriff, City, County or State representatives.
  4. Test system utilizing accepted test equipment to certify proof of performance and Life and Public Safety compliance, FCC, NRTL, NFPA and OSHA compliance.
    - a. Rate system as acceptable or unacceptable at conclusion of test; make only minor adjustments and connections required to show proof of performance.
      - 1) Demonstrate and verify that system complies with performance requirements under operating conditions.
      - 2) Failure of any part of system that precludes completion of system testing, and which cannot be repaired within four hours, terminates acceptance test of that portion of system.
      - 3) Repeated failures that result in a cumulative time of eight hours to affect repairs is cause for entire system to be declared unacceptable.
      - 4) If system is declared unacceptable, retesting must be rescheduled at convenience of Government and costs borne by the contractor.
- J. Acceptance Test Procedure:
1. Physical and Mechanical Inspection: The test team representatives must tour major areas to determine system and sub-systems are completely and properly installed and are ready for acceptance testing.
  2. A system inventory including available spare parts must be taken at this time.

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3. Each item of installed equipment must be re-checked to ensure appropriate NRTL (i.e. UL) certification listing labels are affixed.
  4. Confirm that deficiencies reported during Interim Inspections and Pretesting are corrected prior to start of Acceptance Test.
  5. Inventory system diagrams, record drawings, equipment manuals, pretest results.
  6. Failure of system to meet installation requirements of specifications is grounds for terminating testing and to schedule re-testing.
- K. Operational Test:
1. Individual Item Test: VACO AHJ representative (SMCS 005OP2H3) may select individual items of DAS equipment for detailed proof of performance testing until 100 percent of system has been tested and found to meet requirements of the construction documents.
  2. Government's Condition of Acceptance of System Language:
    - a. Without Acceptance: Until system fully meets conditions of construction documents, system's ownership, use, operation and warranty commences at Government's final acceptance date.
    - b. With Conditional Acceptance: Stating conditions that need to be addressed by contractor or OEM and stating system's use and operation to commence immediately while its warranty commences only at Government's agreed final extended acceptance date.
    - c. With Full Acceptance: Stating system's ownership, use, operation and warranty to immediately commence at Government's agreed to date of final acceptance.
- L. Acceptance Test Conclusion: Reschedule testing on deficiencies and shortages with COR, after COR and SMCS AHJ jointly agree to results of the test, using the generated punch list or discrepancy list. Perform retesting to comply with these specifications at contractor's expense.
- M. Proof of Performance Certification:
1. If system is declared acceptable, AHJ (SMCS 005OP2H3) provides COR notice stating system processes to required operating standards and functions and is Government accepted for use by facility.
  2. Validate items with COR needing to be provided to complete project contract (i.e. charts & diagrams, manuals, spare parts, system warranty documents executed, etc.). Once items have been provided, COR contacts FMS service chief to turn over system from CFM oversight for beneficial use by facility.
  3. If system is declared unacceptable without conditions, rescheduled testing expenses are to be borne by contractor.

### **3.07 CLEANING**

- A. Remove debris, rubbish, waste material, tools, construction equipment, machinery and surplus materials from project site and clean work area, prior to final inspection and acceptance of work.
- B. Put building and premises in neat and clean condition.
- C. Remove debris on a daily basis.
- D. Remove unused material, during progress of work.
- E. Perform cleaning and washing required to provide acceptable appearance and operation of equipment to satisfaction of COR.
- F. Clean exterior surface of all equipment, including concrete residue, dirt, and paint residue, after completion of project.
- G. Perform final cleaning prior to project acceptance by COR.
- H. Remove paint splatters and other spots, dirt, and debris; touch up scratches and mars of finish to match original finish.
- I. Clean devices internally using methods and materials recommended by manufacturer.

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- J. Tighten wiring connectors, terminals, bus joints, and mountings, to include lugs, screws and bolts according to equipment manufacturer's published torque tightening values for equipment connectors. In absence of published connection or terminal torque values, comply with torque values specified in UL 486A-486B.

**3.08 TRAINING**

- A. Provide training in accordance with subsection, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.
- B. Provide training for equipment or system as required in each associated specification.
- C. Develop and submit training schedule for approval by COR, at least 30 days prior to planned training.

**3.09 PROTECTION**

- A. Protection of Fireproofing:
  - 1. Install clips, hangers, clamps, supports and other attachments to surfaces to be fireproofed, if possible, prior to start of spray fireproofing work.
  - 2. Install conduits and other items that would interfere with proper application of fireproofing after completion of spray fire proofing work.
  - 3. Patch and repair fireproofing damaged due to cutting or course of work must be performed by installer of fireproofing and paid for by trade responsible for damage.
- B. Maintain equipment and systems until final acceptance.
- C. Ensure adequate protection of equipment and material during installation and shutdown and during delays pending final test of systems and equipment because of seasonal conditions.

**END OF SECTION**

**SECTION 270526**  
**GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

- A. This section identifies common and general grounding and bonding requirements of communication installations and applies to all sections of Divisions 27 and 28 .

**1.02 RELATED WORK**

- A. Low voltage wiring: Section 27 10 00, Control, Communication and Signal Wiring.

**1.03 SUBMITTALS**

- A. Submit in accordance with Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- B. Provide plan indicating location of system grounding electrode connections and routing of aboveground and underground grounding electrode conductors.
- C. Closeout Submittals: In addition to Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS provide the following:
1. Certified test reports of ground resistance.
  2. Certifications: Two weeks prior to final inspection, submit following to COR:
    - a. Certification materials and installation is in accordance with construction documents.
    - b. Certification complete installation has been installed and tested.

**PART 2 PRODUCTS**

**2.01 COMPONENTS**

- A. Grounding and Bonding Conductors:
1. Provide UL 83 insulated stranded copper equipment grounding conductors, with the exception of solid copper conductors for sizes 6 mm<sup>2</sup> (10 AWG) and smaller. Identify all grounding conductors with continuous green insulation color, except identify wire sizes 25 mm<sup>2</sup> (4 AWG) and larger per NEC.
  2. Provide ASTM B8 bare stranded copper bonding conductors, with the exception of ASTM B1 solid bare copper for wire sizes 6 mm<sup>2</sup> (10 AWG) and smaller.
- B. Ground Rods:
1. Copper clad steel, 19 mm (3/4-inch) diameter by 3000 mm (10 feet) long, conforming to UL 467.
  2. Provide quantity of rods required to obtain specified ground resistance.
- C. Splices and Termination Components: Provide components meeting or exceeding UL 467 and clearly marked with manufacturer's name, catalog number, and permitted conductor sizes.
- D. Telecommunication System Ground Busbars:
1. Telecommunications Main Grounding Busbar (TMGB):
    - a. 6.4 mm (1/4 inch) thick solid copper bar.
    - b. Minimum 100 mm (4 inches) high and length sized in accordance application requirements and future growth of minimum 510 mm (20 inches) long.
    - c. Minimum thirty predrilled attachment points (two rows of fifteen each) for attaching standard sized two-hole grounding lugs.
      - 1) 27 lugs with 15.8 mm (5/8 inch) hole centers.
      - 2) 3 lugs with 25.4 mm (1 inch) hole centers.
    - d. Wall-mount stand-off brackets, assembly screws and insulators for 100 mm (4 inches) standoff from wall.
    - e. Listed as grounding and bonding equipment.
  2. Telecommunications Grounding Busbar (TGB):
    - a. mm (1/4 inch) thick solid copper bar.

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- b. Minimum 50 mm (2 inches) high and length sized in accordance application requirements and future growth of minimum 300 mm long (12 inches) long.
  - c. Minimum nine predrilled attachment points (one row) for attaching standard sized two-hole grounding lugs.
    - 1) 6 lugs with 15.8 mm (5/8 inch) hole centers.
    - 2) 3 lugs with 25.4 mm (1 inch) hole centers.
  - d. Wall-mount stand-off brackets, assembly screws and insulators for 100 mm (4 inches) standoff from wall.
  - e. Listed as grounding and bonding equipment.
- E. Equipment Rack and Cabinet Ground Bars:
- 1. Solid copper ground bars designed for horizontal mounting to framework of open racks or enclosed equipment cabinets:
    - a. mm (3/16 inch) thick by 19.1 mm (3/4 inch) high hard-drawn electrolytic tough pitch 110 alloy copper bar.
    - b. 482 mm (19 inches) or 584 mm (23 inches) EIA/ECA-310-E rack mounting width (as required) for mounting on racks or cabinets.
    - c. Eight 6-32 tapped ground mounting holes on 25.4 mm (1 inch) intervals.
    - d. Four 7.1 mm (0.281 inch) holes for attachment of two-hole grounding lugs.
    - e. Copper splice bar of same material to transition between adjoining racks.
    - f. Two each 12-24 x 19.1 mm (3/4 inch) copper-plated steel screws and flat washers for attachment to rack or cabinet.
    - g. Listed as grounding and bonding equipment.
  - 2. Solid copper ground bars designed for vertical mounting to framework of open racks or enclosed equipment cabinets:
    - a. mm (0.05 inch) thick by 17 mm (0.68 inch) wide tinned copper strip.
    - b. 1997 mm (78 inches) high for mounting vertically on full height racks.
    - c. Holes punched on 15.875 mm-15.875 mm-12.7 mm (5/8"-5/8"-1/2") alternating vertical centers to match EIA/ECA-310-E Universal Hole Pattern for a 45 RMU rack.
    - d. Three #12-24 zinc-plated thread forming hex washer head installation screws, an abrasive pad and antioxidant joint compound.
    - e. NRTL listed as grounding and bonding equipment.
- F. Ground Terminal Blocks: Provide screw lug-type terminal blocks at equipment mounting location (e.g. backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted.
- 1. Electroplated tin aluminum extrusion.
  - 2. Accept conductors ranging from #14 AWG through 2/0.
  - 3. Hold conductors in place by two stainless steel set screws.
  - 4. Two 6 mm (1/4 inch) holes spaced on 15.8 mm (5/8 inch) centers to allow secure two-bolt attachment.
  - 5. Listed as a wire connector.
- G. Splice Case Ground Accessories: Provide splice case grounding and bonding accessories manufactured by splice case manufacturer when available. Otherwise, use 16 mm<sup>2</sup> (6 AWG) insulated ground wire with shield bonding connectors.
- H. Irreversible Compression Lugs:
- 1. Electroplated tinned copper.
  - 2. Two holes spaced on 15.8 mm (5/8 inch) or 25.4 mm (1 inch) centers.
  - 3. Sized to fit the specific size conductor.
  - 4. Listed as wire connectors.
- I. Antioxidant Joint Compound: Oxide inhibiting joint compound for copper-to-copper, aluminum-to-aluminum or aluminum-to-copper connections.

### **PART 3 EXECUTION**

#### **3.01 EQUIPMENT INSTALLATION AND REQUIREMENTS**

- A. Exterior Equipment Grounding: Bond exterior metallic components (including masts and cabinets), antennas, satellite dishes, towers, raceways, primary telecommunications protector/arresters, secondary surge protection, waveguides, cable shields, down conductors and other conductive items to directly to Intersystem Bonding Termination.
- B. Install telecommunications bonding backbone conductor throughout building via telecommunications backbone pathways effectively bonding all interior telecommunications grounding busbars in telecommunications rooms, //antenna headend equipment room, // telephone operators room, //main computer room, // digital telephone (PBX) equipment room, // VoIP active equipment room, // and //network operations room// to telecommunications main grounding busbar in Demarc room after testing bond to verify bonding conductor for telecommunications from grounding electrode conductor is installed per NEC. Size telecommunications bonding backbone conductor as specified in TIA-607-B.
- C. Inaccessible Grounding Connections: Utilize exothermic welding for bonding of buried or otherwise inaccessible connections with the exception of connections requiring periodic testing.
- D. Conduit Systems:
  - 1. Bond ferrous metallic conduit to ground.
  - 2. Bond grounding conductors installed in ferrous metallic conduit at both ends of conduit using grounding bushing with #6 AWG conductor.
- E. Boxes, Cabinets, and Enclosures:
  - 1. Bond each pull box, splice box, equipment cabinet, and other enclosures through which conductors pass (except for special grounding systems for intensive care units and other critical units shown) to ground.
  - 2. Raised Floors: Bonding raised floor components to ground. Refer to details on drawings.
- F. Corrosion Inhibitors: Apply corrosion inhibitor for protecting connection between metals used to contact surfaces, when making ground and ground bonding connections.
- G. Telecommunications Grounding System:
  - 1. Bond telecommunications grounding systems and equipment to facility's electrical grounding electrode at Intersystem Bonding Termination.
  - 2. Provide hardware as required to effectively bond metallic cable shields communications pathways, cable runway, and equipment chassis to ground.
  - 3. Install bonding conductors without splices using shortest length of conductor possible to maintain clearances required by NEC.
  - 4. Provide paths to ground that are permanent and continuous with a resistance of 1 ohm or less from each raceway, cable tray, and equipment connection to telecommunications grounding busbar.
  - 5. Below-Grade Connections: When making exothermic welds, wire brush or file the point of contact to a bare metal surface. Use exothermic welding cartridges and molds in accordance with manufacturer's recommendations. After welds have been made and cooled, brush slag from weld area and thoroughly clean joint areas. Notify COR prior to backfilling at ground connections.
  - 6. Above-Grade Bolted or Screwed Grounding Connections:
    - a. Remove paint to expose entire contact surface by grinding.
    - b. Clean all connector, plate and contact surfaces.
    - c. Apply corrosion inhibitor to surfaces before joining.
  - 7. Bonding Jumpers:
    - a. Assemble bonding jumpers using insulated ground wire of size and type shown on drawings or use a minimum of 16 mm<sup>2</sup> (6 AWG) insulated copper wire terminated with compression connectors of proper size for conductors.



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- b. Use connector manufacturer's compression tool.
- 8. Bonding Jumper Fasteners:
  - a. Conduit: Connect bonding jumpers using lugs on grounding bushings or clamp pads on push-type conduit fasteners. Where appropriate, use zinc-plated external tooth lockwashers or Belleville Washers.
  - b. Wireway and Cable Tray: Fasten bonding jumpers using zinc-plated bolts, external tooth lockwashers or Belleville washers and nuts. Install protective cover, e.g., zinc-plated acorn nuts, on bolts extending into wireway or cable tray to prevent cable damage.
  - c. Grounding Busbars: Fasten bonding conductors using two-hole compression lugs. Use 300 series stainless steel bolts, Belleville Washers, and nuts.
  - d. Slotted Channel Framing and Raised Floor Stringers: Fasten bonding jumpers using zinc-plated, self-drill screws and Belleville washers or external tooth lock washers.
- H. Telecommunications Room Bonding:
  - 1. Telecommunications Grounding Busbars:
    - a. Install busbar hardware no less than 950 mm (18 inches) A.F.F.
    - b. Where other grounding busbars are located in same room, e.g. electrical panelboard for telecommunications equipment, bond busbars together as indicated on grounding riser diagrams.
    - c. Make conductor connections with two-hole compression lugs sized to fit busbar and conductors.
    - d. Attach lugs with stainless steel hardware after preparing bond according to manufacturer recommendations and treating bonding surface on busbar with anti-oxidant to help prevent corrosion.
  - 2. Telephone-Type Cable Rack Systems:
    - a. Aluminum pan installed on telephone-type cable rack serves as primary ground conductor within communications room.
    - b. Make ground connections by installing bonding jumpers:
      - 1) Install minimum 16 mm<sup>2</sup> (6 AWG) bonding between telecommunications ground busbars and the aluminum pan installed on cable rack.
      - 2) Install 16 mm<sup>2</sup> (6 AWG) bonding jumpers across aluminum pan junctions.
- I. Self-Supporting and Cabinet-Mounted Equipment Rack Ground Bars:
  - 1. Install rack-mount horizontal busbar or vertical busbar to provide multiple bonding points,
  - 2. At each rack or cabinet containing active equipment or shielded cable terminations:
    - a. Bond busbar to ground as part of overall telecommunications bonding and grounding system.
    - b. Bond copper ground bars together using solid copper splice plates manufactured by same ground bar manufacturer, when ground bars are provided at rear of lineup of bolted together equipment racks.
    - c. Bond non-adjacent ground bars on equipment racks and cabinets with 16 mm<sup>2</sup> (6 AWG) insulated copper wire bonding jumpers attached at each end with compression-type connectors and mounting bolts.
    - d. Provide 16 mm<sup>2</sup> (6 AWG) bonding jumpers between rack and cabinet ground busbars and overhead cable runway or raised floor stringers, as appropriate.
- J. Backboards: Provide a screw lug-type terminal block or drilled and tapped copper strip near top of backboards used for communications cross-connect systems. Connect backboard ground terminals to cable runway using an insulated 16 mm<sup>2</sup> (6 AWG) bonding jumper.
- K. Other Communication Room Ground Systems: Ground metallic conduit, wireways, and other metallic equipment located away from equipment racks or cabinets to cable tray or telecommunications ground busbar, whichever is closer, using insulated 16 mm<sup>2</sup> (6 AWG) ground wire bonding jumpers.
- L. Communications Cable Grounding:

1. Bond all metallic cable sheaths in multi-pair communications cables together at each splicing or terminating location to provide 100 percent metallic sheath continuity throughout communications distribution system.
  2. Install a cable shield bonding connector with a screw stud connection for ground wire, at terminal points. Bond cable shield connector to ground.
  3. Bond all metallic cable shields together within splice closures using cable shield bonding connectors or splice case manufacturer's splice case grounding and bonding accessories. When an external ground connection is provided as part of splice closure, connect to an effective ground source and bond all other metallic components and equipment at that location.
- M. Communications Cable Tray Systems:
1. Bond metallic structures of cable tray to provide 100 percent electrical continuity throughout cable tray systems.
  2. Where metallic cable tray systems are mechanically discontinuous:
    - a. Install splice plates provided by cable tray manufacturer between cable tray sections so resistance across a bolted connection is 0.010 ohms or less, as verified by measuring across splice plate connection.
    - b. Install 16 mm<sup>2</sup> (6 AWG) bonding jumpers across each cable tray splice or junction where splice plates cannot be used.
  3. Bond cable tray installed in same room as telecommunications grounding busbar to busbar.
- N. Communications Raceway Grounding:
1. Conduit: Use insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers to bond metallic conduit at both ends and intermediate metallic enclosures to ground.
  2. Cable Tray Systems: Use insulated 16 mm<sup>2</sup> (6 AWG) grounding jumpers to bond cable tray to column-mounted building ground plates (pads) at both ends and approximately 16 meters (50 feet) on centers.
- O. Ground Resistance:
1. Install telecommunications grounding system so resistance to grounding electrode system measures 5 ohms or less.
  2. Measure grounding electrode system resistance using an earth test meter, clamp-on ground tester, or computer-based ground meter as defined in IEEE 81. Record ground resistance measurements before electrical distribution system is energized.
  3. Backfill only after below-grade connection have been visually inspected by COR. Notify COR twenty-four hours before below-grade connections are ready for inspection.
- P. Ground Rod Installation:
1. Drive each rod vertically in earth minimum 3000 mm (10 feet) in depth.
  2. Make connections by exothermic process to form solid metal joints, where permanently concealed ground connections are required. Make accessible ground connections with mechanical pressure type ground connectors.
  3. Install angled ground rods or grounding electrodes in horizontal trenches to achieve specified resistance, where rock prevents driving of vertical ground rods.

### 3.02 FIELD QUALITY CONTROL

- A. Perform tests per BICSI's Information Technology Systems Installation Methods Manual (ITSIMM), Recommended Testing Procedures and Criteria.
- B. Perform two-point bond test using trained installers qualified to use test equipment.
- C. Conduct continuity test to verify that metallic pathways in telecommunications spaces are bonded to TGB or TMGB.
- D. Conduct electrical continuity test to verify that TMGB is effectively bonded to grounding electrode conductor.

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- E. Visually inspect to verify that screened and shielded cables are bonded to TGB or TMGB.
- F. Perform a resistance test to ensure patch panel, rack and cabinet bonding connection resistance measures less than 5 Ohms to TGB or TMGB.

**END OF SECTION**

**SECTION 270533**  
**RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

- A. This section specifies conduit, fittings, and boxes to form complete, coordinated, raceway systems. Raceways are required for communications cabling unless shown or specified otherwise.

**1.02 RELATED WORK**

- A. Bedding of conduits: Section 31 20 00, EARTH MOVING.
- B. Mounting board for Telecommunication Rooms: Section 06 10 00, ROUGH CARPENTRY.
- C. Sealing around penetrations to maintain integrity of fire rated construction: Section 07 84 00, FIRESTOPPING.
- D. Fabrications for deflection of water away from building envelope at penetrations: Section 07 60 00, FLASHING AND SHEET METAL.
- E. Sealing around conduit penetrations through building envelope to prevent moisture migration into building: Section 07 92 00, JOINT SEALANTS.
- F. Identification and painting of conduit and other devices: Section 09 91 00, PAINTING.
- G. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

**1.03 SUBMITTALS**

- A. In accordance with Section 27 50 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS, submit the following:
  - 1. Size and location of cabinets, splice boxes and pull boxes.
  - 2. Layout of required conduit penetrations through structural elements.
  - 3. Catalog cuts marked with specific item proposed and area of application identified.
- B. Certification: Provide letter prior to final inspection, certifying material is in accordance with construction documents and properly installed.

**PART 2 PRODUCTS**

**2.01 MATERIAL**

- A. Minimum Conduit Size: 19 mm (3/4 inch).
- B. Conduit:
  - 1. Rigid Galvanized Steel: Conform to UL 6, ANSI C80.1.
  - 2. Rigid Aluminum: Conform to UL 6A, ANSI C80.5.
  - 3. Rigid Intermediate Steel Conduit (IMC): Conform to UL 1242, ANSI C80.6.
  - 4. Electrical Metallic Tubing (EMT):
    - a. Maximum Size: 105 mm (4 inches).
    - b. Install only for cable rated 600 volts or less.
    - c. Conform to UL 797, ANSI C80.3.
  - 5. Flexible Galvanized Steel Conduit: Conform to UL 1.
  - 6. Liquid-tight Flexible Metal Conduit: Conform to UL 360.
  - 7. Direct Burial Plastic Conduit: Conform to UL 651 and UL 651A, heavy wall PVC, or high density polyethylene (HDPE).
  - 8. Surface Metal Raceway: Conform to UL 5.
  - 9. Wireway, Approved "Basket": Provide "Telecommunications Service" rated with approved length way partitions and cable straps to prevent wires and cables from changing from one partitioned pathway to another.

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C. Conduit Fittings:

1. Rigid Galvanized Steel and Rigid Intermediate Steel Conduit Fittings:
  - a. Provide fittings meeting requirements of UL 514B and ANSI/ NEMA FB 1.
  - b. Sealing: Provide threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water and vapor. In concealed work, install sealing fittings in flush steel boxes with blank cover plates having same finishes as other electrical plates in room.
  - c. Standard Threaded Couplings, Locknuts, Bushings, and Elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
  - d. Locknuts: Bonding type with sharp edges for digging into metal wall of an enclosure.
  - e. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into metallic body of fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
  - f. Erickson (union-type) and Set Screw Type Couplings:
    - 1) Couplings listed for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete.
    - 2) Use set screws of case hardened steel with hex head and cup point to seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
  - g. Provide OEM approved fittings.
2. Rigid Aluminum Conduit Fittings:
  - a. Standard Threaded Couplings, Locknuts, Bushings, and Elbows: Malleable iron, steel or aluminum alloy materials; Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are not permitted.
  - b. Locknuts and Bushings: As specified for rigid steel and IMC conduit.
  - c. Set Screw Fittings: Not permitted for use with aluminum conduit.
3. Electrical Metallic Tubing Fittings:
  - a. Conform to UL 514B and ANSI/ NEMA FB1; only steel or malleable iron materials are acceptable.
  - b. Couplings and Connectors: Concrete tight and rain tight, with connectors having insulated throats.
    - 1) Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller.
    - 2) Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches).
    - 3) Use set screws of case-hardened steel with hex head and cup point to seat in wall of conduit for positive grounding.
  - c. Indent type connectors or couplings are not permitted.
  - d. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are not permitted.
  - e. Provide OEM approved fittings.
4. Flexible Steel Conduit Fittings:
  - a. Conform to UL 514B; only steel or malleable iron materials are acceptable.
  - b. Provide clamp type, with insulated throat.
  - c. Provide OEM approved fittings.
5. Liquid-tight Flexible Metal Conduit Fittings:
  - a. Conform to UL 514B and ANSI/ NEMA FB1; only steel or malleable iron materials are acceptable.
  - b. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening.
  - c. Provide connectors with insulated throats to prevent damage to cable jacket.
  - d. Provide OEM approved fittings.

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6. Direct Burial Plastic Conduit Fittings: Provide fittings meeting requirements of UL 514C and NEMA TC3, and as recommended by conduit manufacturer.
  7. Surface Metal Raceway: Conform to UL 5 and "telecommunications service" rated with approved length-way partitions and cable straps to prevent wires and cables from changing from one partitioned pathway to another.
  8. Surface Metal Raceway Fittings: As recommended by raceway manufacturer.
  9. Expansion and Deflection Couplings:
    - a. Conform to UL 467 and UL 514B.
    - b. Accommodate 19 mm (3/4 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
    - c. Include internal flexible metal braid sized to ensure conduit ground continuity and fault currents in accordance with UL 467, and NEC code tables for ground conductors.
    - d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.
  10. Rigid Aluminum Fittings:
    - a. Provide malleable iron, steel or aluminum alloy materials; zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
    - b. Locknuts and Bushings: As specified for rigid steel and IMC conduit.
    - c. Set Screw Fittings: Not permitted for use with aluminum conduit.
    - d. Indent type connectors or couplings are prohibited.
    - e. Die-cast or pressure-cast zinc-alloy fit-tings or fittings made of "pot metal" are not permitted.
    - f. Provide OEM approved fittings.
  11. Wireway Fittings: As recommended by wireway OEM.
- D. Conduit Supports:
1. Parts and Hardware: Provide zinc-coat or equivalent corrosion protection.
  2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
  3. Multiple Conduit (Trapeze) Hangers: Minimum 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 2.78 mm (12 gage) steel, cold formed, lipped channels; with minimum 9 mm (3/8 inch) diameter steel hanger rods.
  4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
- E. Outlet, Splice, and Pull Boxes:
1. Conform to UL-50 and UL-514A.
  2. Cast metal where required by NEC or shown, and equipped with rustproof boxes.
  3. Sheet Metal Boxes: Galvanized steel, except where otherwise shown.
  4. Install flush mounted wall or ceiling boxes with raised covers so that front face of raised cover is flush with wall.
  5. Install surface mounted wall or ceiling boxes with surface style flat or raised covers.
- F. Wireways: Equip with hinged covers, except where removable covers are shown.
- G. Warning Tape: Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type, red with black letters, and imprinted with "CAUTION BURIED COMMUNICATIONS CABLE BELOW".
- H. Flexible Nonmetallic Communications Raceway (Innerduct) and Fittings:
1. General: Provide UL 910 listed plenum, riser, and general purpose corrugated pliable communications raceway for optical fiber cables and communications cable applications; select in accordance with provisions of NEC Articles 770 and 800.
  2. Provide Communications Raceway with a factory installed 567 kg (1250 lb.) tensile pre-lubricated pull tape.

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3. Use only metallic straps, hangers and fittings to support raceway from building structure. Cable ties are not permitted for securing raceway to building structure.
  4. Provide fittings to be installed in spaces used for environmental air made of materials that do not exceed flammability, smoke generation, ignitibility, and toxicity requirements of environmental air space.
  5. Size: Metric Designator 53 (trade size 2) or smaller.
  6. Outside Plant: Plenum-rated where each innerduct is 75 mm (3 inches) and larger.
  7. Inside Plant: Listed and marked for installation in plenum airspaces and minimum 25 mm (1 inch) inside diameter.
  8. Plenum: Non-metallic communications raceway.
    - a. Constructed of low smoke emission, flame retardant PVC with corrugated construction.
    - b. UL 94 V-O rating for flame spreading limitation.
  9. Provide innerduct reel lengths as necessary to ensure ducts are continuous; one piece runs from ENTR to MH; MH to MH; DEMARC to MCR/TER; TR to TR. Innerduct connectors are not permitted between rooms.
  10. Provide pulling accessories used for innerduct including but not limited to, inner duct lubricants, spreaders, applicators, grips, swivels, harnesses, and line missiles (blown air) compatible with materials being pulled.
- I. Outlet Boxes:
1. Flush wall mounted minimum 11.9 cm (4-11/16 inches) square, 9.2 cm (3-5/8 inches) deep pressed galvanized steel.
  2. //Flush wall mounted 12.7 cm (5 inches) square x 7.3 cm (2-7/8 inches); deep pressed galvanized steel.//
  3. 2-Gang Tile Box:
    - a. Flush backbox type for installation in block walls.
    - b. Minimum 92 mm (3-5/8 inches) deep.
- J. Weatherproof Outlet Boxes: Surface mount two gang, 67 mm (2-5/8 inches) deep weatherproof cast aluminum with powder coated finish internal threads on hubs 19 mm (3/4 inch) minimum.
- K. Cable Tray:
1. Provide wire basket type of sizes indicated; with all required splicing and mounting hardware.
  2. Materials and Finishes:
    - a. Electro-plated zinc galvanized (post plated) made from carbon steel and plated to ASTM B 633, Type III, SC-1.
    - b. Remove soot, manufacturing residue/oils, or metallic particles after fabrication.
    - c. Rounded edges and smooth surfaces.
  3. Provide continuous welded top side wire to protect cable insulation and installers.
  4. High strength steel wires formed into a 50 x 100 mm (2 inches by 4 inches) wire mesh pattern with intersecting wires welded together.
  5. Wire Basket Sizes:
    - a. Wire Diameter: 5 mm (0.195 inch) minimum on all mesh sections.
    - b. Usable Loading Depth: 105 mm (4 inch) // 150 mm (6 inches) // .
    - c. Width: 300 mm (12 inches) // 450 mm (18 inches) // 600 mm (24 inches) // .
  6. Fittings: Field-formed, from straight sections, in accordance with manufacturer's instructions.
  7. Provide accessories to protect, support and install wire basket tray system.
- L. Cable Duct: Equip with hinged covers, except where removable covers are accepted by COR.
- M. Cable Duct Fittings: As recommended by cable duct OEM.

**PART 3 EXECUTION**

**3.01 EQUIPMENT INSTALLATION AND REQUIREMENTS**

A. Raceways typically required for cabling systems unless otherwise indicated:

<b>System</b>	<b>Specification Section</b>	<b>Installed Method</b>
Grounding	27 05 26	Conduit Not Required
Control, Communication and Signal Wiring	27 10 00	Complete Conduit Allowed in Non-Partitioned Cable Tray or Cable Ladders
Communications Structured Cabling	27 15 00	Conduit to Cable Tray Partitioned Cable Tray
Master Antenna Television Equipment and Systems	27 41 31	Conduit to Cable Tray, Partitioned Cable Tray
Public Address and Mass Notification Systems	27 51 16	Complete conduit
Intercommunications and Program systems	27 51 23	Conduit to Cable Tray, Partitioned Cable Tray
Nurse Call	27 52 23	Complete Conduit
Security Emergency Call, Duress Alarm, and Telecommunications	27 52 31	Conduit to Cable Tray, Partitioned Cable Tray
Miscellaneous Medical Systems	27 52 41	Complete Conduit
Distributed Radio Antenna Equipment and System	27 53 19	Conduit to Cable Tray, Partitioned Cable Tray
Grounding and Bonding for Electronic Safety and Security	28 05 26	Conduit Not Required Unless Required by Code
Physical Access Control System	28 13 00	Conduit to Cable Tray Partitioned Cable Tray
Physical Access Control System and Database Management	28 13 16	Conduit to Cable Tray Partitioned Cable Tray
Security Access Detection	28 13 53	Complete Conduit
Intrusion Detection System	28 16 00	Conduit to Cable Tray, Partitioned Cable Tray
Video Surveillance	28 23 00	Complete Conduit
Electronic Personal Protection System	28 26 00	Conduit to Cable Tray, Partitioned Cable Tray

B. Penetrations:

1. Cutting or Holes:

- a. Locate holes in advance of installation. Where they are proposed in structural sections, obtain approval of structural engineer and COR prior to drilling through structural sections.
- b. Make holes through concrete and masonry in new // and existing // structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not permitted; COR may grant limited permission by request, in condition of limited working space.



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- c. Fire Stop: Where conduits, wireways, and other communications raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING.
  - 1) Fill and seal clearances between raceways and openings with fire stop material.
  - 2) Install only retrofittable, non-hardening, and reusable firestop material that can be removed and reinstalled to seal around cables inside conduits.
- d. Waterproofing at Floor, Exterior Wall, and Roof Conduit Penetrations:
  - 1) Seal clearances around conduit and make watertight as specified in Section 07 92 00, JOINT SEALANTS // or directed by waterproofing manufacturer. //

C. Conduit Installation:

1. Minimum conduit size of 19 mm (3/4 inch), but not less than size required for 40 percent fill.
2. Install insulated bushings on all conduit ends.
3. Install pull boxes after every 180 degrees of bends (two 90 degree bends). Size boxes per TIA 569.
4. Extend vertical conduits/sleeves through floors minimum 75 mm (3 inches) above floor and minimum 75 mm (3 inches) below ceiling of floor below.
5. Terminate conduit runs to and from a backboard in a closet or interstitial space at top or bottom of backboard. Install conduits to enter telecommunication rooms next to wall and flush with backboard.
6. Where drilling is necessary for vertical conduits, locate holes so as not to affect structural sections.
7. Seal empty conduits located in telecommunications rooms or on backboards with a standard non-hardening putty compound to prevent entrance of moisture and gases and to meet fire resistance requirements.
8. Minimum radius of communication conduit bends:

Sizes of Conduit Trade Size	Radius of Conduit Bends mm, Inches
3/4	150 (6)
1	230 (9)
1-1/4	350 (14)
1-1/2	430 (17)
2	525 (21)
2-1/2	635 (25)
3	775 (31)
3-1/2	900 (36)
4	1125 (45)

9. Provide 19 mm (3/4 inch) thick fire retardant plywood specified in Section 06 10 00, ROUGH CARPENTRY on wall of communication closets where shown on drawings. Mount plywood with bottom edge 300 mm (12 inches) above finished floor and top edge 2.74 m (9 feet) A.F.F.
10. Provide pull wire in all empty conduits; sleeves through floor are exceptions.
11. Complete each entire conduit run installation before pulling in cables.
12. Flattened, dented, or deformed conduit is not permitted.
13. Ensure conduit installation does not encroach into ceiling height head room, walkways, or doorways.
14. Cut conduit square with a hacksaw, ream, remove burrs, and draw tight.
15. Install conduit mechanically continuous.

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16. Independently support conduit at 2.44 m (8 feet) on center; do not use other supports (i.e., suspended ceilings, suspended ceiling supporting members, luminaires, conduits, mechanical piping, or mechanical ducts).
  17. Support conduit within 300 mm (1 foot) of changes of direction, and within 300 mm (1 foot) of each enclosure to which connected.
  18. Close ends of empty conduit with plugs or caps to prevent entry of debris, until cables are pulled in.
  19. Conduit installations under fume and vent hoods are prohibited.
  20. Attach conduits to cabinets, splice cases, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on inside of enclosure, made up wrench tight. Do not make conduit connections to box covers.
  21. Do not use aluminum conduits in wet locations.
  22. Unless otherwise indicated on drawings or specified herein, conceal conduits within finished walls, floors and ceilings.
  23. Conduit Bends:
    - a. Make bends with standard conduit bending machines; observe minimum bend radius for cable type and outside diameter.
    - b. Conduit hickey is permitted only for slight offsets, and for straightening stubbed conduits.
    - c. Bending of conduits with a pipe tee or vise is not permitted.
  24. Layout and Homeruns - Deviations: Make only where necessary to avoid interferences and only after drawings showing proposed deviations have been submitted and approved by COR.
- D. Concealed Work Installation:
1. In Concrete:
    - a. Conduit: Rigid steel or IMC.
    - b. Align and run conduit in direct lines.
    - c. Install conduit through concrete beams only when the following occurs:
      - 1) Where shown on structural drawings.
      - 2) As accepted by COR prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
    - d. Installation of conduit in concrete that is less than 75 mm (3 inches) thick is prohibited.
      - 1) Conduit outside diameter larger than 1/3 of slab thickness is prohibited.
      - 2) Space between Conduits in Slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.
      - 3) Install conduits approximately in center of slab to ensure a minimum of 19 mm (3/4 inch) of concrete around conduits.
    - e. Make couplings and connections watertight. Use thread compounds that are NRTL listed conductive type to ensure low resistance ground continuity through conduits. Tightening set screws with pliers is not permitted.
- E. Furred or Suspended Ceilings and in Walls:
1. Rigid steel, //IMC// or rigid aluminum. Different type conduits mixed indiscriminately in same system is not permitted.
  2. Align and run conduit parallel or perpendicular to building lines.
  3. Tightening set screws with pliers is not permitted.
- F. Exposed Work Installation:
1. Unless otherwise indicated on drawings, exposed conduit is only permitted in telecommunications rooms.
    - a. Provide rigid steel, IMC or rigid aluminum.
    - b. Different type of conduits mixed indiscriminately in system is not permitted.
  2. Align and run conduit parallel or perpendicular to building lines.

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3. Install horizontal runs close to ceiling or beams and secure with conduit straps.
  4. Support horizontal or vertical runs at not over 2400 mm (96 inches) intervals.
  5. Surface Metal Raceways: Use only where shown on drawings.
  6. Painting:
    - a. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
    - b. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color.
    - c. Provide labels where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.
- G. Expansion Joints:
1. Conduits 75 mm (3 inches) and larger, that are secured to building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install couplings in accordance with manufacturer's recommendations.
  2. Provide conduits smaller than 75 mm (3 inches) with pull boxes on both sides of expansion joint. Connect conduits to expansion and deflection couplings as specified.
  3. Install expansion and deflection couplings where shown.
- H. Seismic Areas:
1. In seismic areas, follow H-18-8 Seismic Design Requirements.
  2. Rigidly secure conduit to building structure on opposite sides of a building expansion joint with pull boxes on both sides of joint.
  3. Connect conduits to pull boxes with 375 mm (15 inches) of slack flexible conduit.
  4. Install green copper wire minimum #6 AWG in flexible conduit for bonding jumper.
- I. Conduit Supports, Installation:
1. Select AC193 code listed mechanical anchors or fastening devices with safe working load not to exceed 1/4 of proof test load.
  2. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.
  3. Support multiple conduit runs with trapeze hangers. Use trapeze hangers designed to support a load equal or greater than sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other accepted fasteners.
  4. Support conduit independent of pull boxes, luminaires, suspended ceiling components, angle supports, duct work, and similar items.
  5. Fastenings and Supports in Solid Masonry and Concrete:
    - a. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing concrete.
    - b. Existing Construction:
      - 1) Code AC193 listed wedge type steel expansion anchors minimum 6 mm (1/4 inch) bolt size and minimum 28 mm (1-1/8 inch) embedment.
      - 2) Power set fasteners minimum 6 mm (1/4 inch) diameter with depth of penetration minimum 75 mm (3 inches).
      - 3) Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
  6. Fastening to Hollow Masonry: Toggle bolts are permitted.
  7. Fastening to Metal Structures: Use machine screw fasteners or other devices designed and accepted for application.
  8. Bolts supported only by plaster or gypsum wallboard are not acceptable.
  9. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
  10. Do not support conduit from chain, wire, or perforated strap.
  11. Spring steel type supports or fasteners are not permitted except horizontal and vertical supports/fasteners within walls.
  12. Vertical Supports:

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- a. Install riser clamps and supports for vertical conduit runs in accordance with NEC.
  - b. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.
- J. Box Installation:
1. Boxes for Concealed Conduits:
    - a. Flush mounted.
    - b. Provide raised covers for boxes to suit wall or ceiling, construction and finish.
  2. In addition to boxes shown, install additional boxes where needed to prevent damage to cables during pulling.
  3. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
  4. Stencil or install phenolic nameplates on covers of boxes identified on riser diagrams; for example "SIG-FA JB No. 1".
  5. Outlet boxes mounted back-to-back in same wall are not permitted. A minimum 600 mm (24 inches) center-to-center lateral spacing must be maintained between boxes.
- K. Flexible Nonmetallic Communications Raceway (Innerduct), Installation:
1. Install supports from building structure for horizontal runs at intervals not to exceed 900 mm (3 feet) and at each end.
  2. Install supports from building structure for vertical runs at intervals not to exceed 1.2 m (4 feet) and at each side of joints.
  3. Install only in accessible spaces not subject to physical damage or corrosive influences.
  4. Make bends manually to assure internal diameter of tubing is not effectively reduced.
  5. Extend each segment of innerduct minimum 300 mm (12 inches) beyond end of service conduit tie or cable tray. Restrain innerduct ends with wall mount clamps and seal when cable is installed.

### 3.02 TESTING

- A. Examine fittings and locknuts for secureness.
- B. Test RMC, IMC and EMT systems for electrical continuity.
- C. Perform simple continuity test after cable installation.

**END OF SECTION**

**SECTION 270561**  
**LEASED SPACE, COMMUNICATIONS EQUIPMENT AND SYSTEMS**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

- A. This section includes leased space communications equipment and systems for VA Construction projects utilizing Solicitation for Offers (SFO) Design Guide and other government approved projects utilizing non-government owned facilities.

**1.02 RELATED WORK**

- A. Electrical conductors and cables in electrical systems rated 600 V and below: Section 26 05 21, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
- B. Lightning protection system: Section 26 41 00, FACILITY LIGHTNING PROTECTION.
- C. General electrical requirements that are common to more than one section in Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- D. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- E. Conduits for cables and wiring: Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- F. Low voltage cabling system infrastructure: Section 27 10 00, CONTROL, COMMUNICATION AND SIGNAL WIRING.
- G. Equipment cabinets, enclosures, racks, and associated hardware in telecommunications rooms: Section 27 11 00, TELECOMMUNICATIONS ROOM FITTINGS.
- H. Voice and data cable distribution system and associated equipment: Section 27 15 00, COMMUNICATIONS STRUCTURED CABLING.
- I. Voice communication switching and routing equipment: Section, 27 31 00 VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT.
- J. Extension of a voice communication switching and routing system: Section 27 31 31, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT EXTENSION.
- K. Emergency 2-way radio equipment: Section 27 32 41, TWO-WAY RADIO EQUIPMENT AND SYSTEMS.
- L. High Definition (HDTV) Master Antenna Television (MATV) system and associated equipment: Section 27 41 31, MASTER ANTENNA TELEVISION EQUIPMENT AND SYSTEMS.
- M. Emergency Service Public Address System (PAS) and associated equipment: Section 27 51 16, PUBLIC ADDRESS AND MASS NOTIFICATION SYSTEMS.
- N. Intercom Systems: Section 27 51 23, INTERCOMMUNICATIONS AND PROGRAM SYSTEMS.
- O. Nurse-Call and Code Blue Communication Systems and associated equipment: Section 27 52 23, NURSE CALL AND CODE BLUE SYSTEMS.
- P. Security Unit Door Signal Systems, Narcotics Storage Signal Systems and Elapsed Time Indicators: Section 27 52 41, MISCELLANEOUS MEDICAL SYSTEMS.
- Q. Local two way communication systems for Public Safety Radio, VA radios, commercial Wireless Service Providers, and Cellular equipment: Section 27 53 19, DISTRIBUTED RADIO ANTENNA (WITHIN BUILDING) EQUIPMENT AND SYSTEM.
- R. Emergency Call telephones, intercom systems, with blue strobe light and Equipment: Section 28 52 31, SECURITY EMERGENCY CALL/DURESS.

- S. General requirements common to more than one section in Division 28: Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
- T. Physical Access Control System field-installed Controllers connected by data transmission network: Section 28 13 00, PHYSICAL ACCESS DETECTION.
- U. Physical Access Control Database Management System: Section 28 13 16, PHYSICAL ACCESS CONTROL SYSTEM AND DATABASE MANAGEMENT.
- V. Detection and Screening Systems: Section 28 13 53, SECURITY ACCESS DETECTION.
- W. Intrusion sensors and detection devices, and communication links to perform monitoring, alarm, and control functions: Section 28 16 11, INTRUSION DETECTION EQUIPMENT AND SYSTEMS.
- X. Video surveillance system cameras, data transmission wiring, and control stations with associated equipment: Section 28 23 00, VIDEO SURVEILLANCE EQUIPMENT AND SYSTEMS.
- Y. Duress-Panic Alarms, Emergency Phones / Call-Boxes, Intercom Systems, data transmission wiring and associated equipment: Section 28 26 00, ELECTRONIC PERSONAL PROTECTION EQUIPMENT AND SYSTEMS.

## **PART 2 PRODUCTS**

### **2.01 SCHEDULE FOR LEASED EQUIPMENT AND SYSTEMS**

- A. Insert schedule for leased equipment and systems.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION REQUIREMENTS**

- A. Follow all manufacturers' recommendations and guidelines.

**END OF SECTION**

**SECTION 270800.01**  
**DVA/USACE PROJECTS COMMISSIONING OF COMMUNICATIONS SYSTEMS**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

- A. This section includes requirements for commissioning facility communications systems, related subsystems and related equipment. This Section supplements general requirements specified in Section 01 91 00.01 DVA/USACE Projects GENERAL COMMISSIONING REQUIREMENTS.
- B. Complete list of equipment and systems to be commissioned is specified in Section 01 91 00.01 DVA/USACE Projects GENERAL COMMISSIONING REQUIREMENTS and Specification 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- C. Commissioned Systems:
  - 1. Commissioning of systems specified in Division 27 and 28 is part of project's construction process including documentation and proof of performance testing of these systems, as well as training of VA's Operation and Maintenance personnel in accordance with requirements of Section 01 91 00.01 DVA/USACE Projects GENERAL COMMISSIONING REQUIREMENTS and Division 27, in cooperation with Government, CxM and CxA.
  - 2. The facility exterior closure systems commissioning includes communications systems listed in Section 01 91 00.01 DVA/USACE Projects GENERAL COMMISSIONING REQUIREMENTS and 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

**1.02 RELATED WORK**

- A. System tests: Also, coordinate with the USACE PM for applicable UFGS GENERAL REQUIREMENTS sections..
- B. Commissioning process requires review of selected submittals that pertain to systems to be commissioned: UFGS Section 01 33 00 SUBMITTAL PROCEDURES.
- C. Construction phase commissioning process and procedures including roles and responsibilities of commissioning team members and user training: Section 01 91 00.01 DVA/USACE Projects GENERAL COMMISSIONING REQUIREMENTS.

**1.03 COORDINATION**

- A. CxM will provide a list of submittals that must be reviewed by CxM and CxA simultaneously with engineering review; do not proceed with work of sections identified without review completion by CxA, CxM and engineering.
- B. Commissioning of communications systems require inspection of individual elements of communications system construction throughout construction period. Coordinate with CxM in accordance with Section 01 91 00.01 DVA/USACE Projects GENERAL COMMISSIONING REQUIREMENTS and commissioning plan to schedule communications systems inspections as required to support the commissioning process.

**1.04 CLOSEOUT SUBMITTALS**

- A. Refer to Section 01 91 00.01 DVA/USACE Projects GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for pre-functional checklists, equipment startup reports, and other commissioning documents.
- B. Pre-Functional Checklists:
  - 1. Complete pre-functional checklists provided by CxM to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing.
  - 2. Submit completed checklists to COR, CxM and CxA. CxM and CxA can spot check a sample of completed checklists. If CxM and CxA determine that information provided on the checklist is not accurate, CxM then returns the marked-up checklist to Contractor for correction and resubmission.

3. If CxM and CxA determine that a significant number of completed checklists for similar equipment are not accurate, CxM in coordination with CxA will select a broader sample of checklists for review.
4. If CxM and CxA determine that a significant number of broader sample of checklists is also inaccurate, all checklists for the type of equipment will be returned to Contractor for correction and resubmission.

**1.05 SUBMIT TRAINING AGENDAS AND TRAINER RESUMES IN ACCORDANCE WITH REQUIREMENTS OF SECTION 01 91 00.01 DVA/USACE PROJECTS GENERAL COMMISSIONING REQUIREMENTS.**

**PART 1 PRODUCTS - NOT USED**

**PART 2 EXECUTION**

**3.01 FIELD QUALITY CONTROL**

- A. Contractor's Tests:
  1. Scheduled tests required by other sections of Division 27 must be documented in accordance with Section 01 00 00.01 DVA/USACE Projects GENERAL REQUIREMENTS.
  2. Incorporate all testing into project schedule. Provide minimum seven calendar days' notice of testing for CxM to witness selected Contractor tests at sole discretion of CxM and CxA. The CxA and other Government representative(s) may choose to participate in some or all the testing procedures as observers.
  3. Complete tests prior to scheduling Systems Functional Performance Testing.
- B. Systems Functional Performance Testing:
  1. Commissioning process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions.
  2. CxM prepares final and detailed Systems Functional Performance Test procedures for review and acceptance by CxA and COR.
  3. Provide required labor, materials, and test equipment identified in test procedure to perform tests.
  4. CxM must witness and document the testing.
    - a. Provide test reports to CxM and CxA. CxM will sign test reports to verify tests were performed.

**3.02 TRAINING**

- A. Training of Government's operation and maintenance personnel is required in cooperation with COR, VA Resident Engineer, and CxM.
- B. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning location, operation, and troubleshooting of installed systems.
- C. Schedule instruction in coordination with COR and CxM after submission and approval of formal training plans.

**END OF SECTION**



**SECTION 270800**  
**COMMISSIONING OF COMMUNICATIONS SYSTEMS**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

- A. This section includes requirements for commissioning facility communications systems, related subsystems and related equipment. This Section supplements general requirements specified in Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- B. Complete list of equipment and systems to be commissioned is specified in Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS and Specification 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- C. Commissioned Systems:
  - 1. Commissioning of systems specified in Division 27 // and 28 // is part of project's construction process including documentation and proof of performance testing of these systems, as well as training of VA's Operation and Maintenance personnel in accordance with requirements of Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS and Division 27, in cooperation with Government and Commissioning Agent.
  - 2. The facility exterior closure systems commissioning includes communications systems listed in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

**1.02 RELATED WORK**

- A. System tests: Section 01 00 00, GENERAL REQUIREMENTS.
- B. Commissioning process requires review of selected submittals that pertain to systems to be commissioned: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- C. Construction phase commissioning process and procedures including roles and responsibilities of commissioning team members and user training: Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

**1.03 COORDINATION**

- A. Commissioning Agent will provide a list of submittals that must be reviewed by Commissioning Agent simultaneously with engineering review; do not proceed with work of sections identified without engineering and Commissioning Agent's review completed.
- B. Commissioning of communications systems require inspection of individual elements of communications system construction throughout construction period. Coordinate with Commissioning Agent in accordance with Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS and commissioning plan to schedule communications systems inspections as required to support the commissioning process.

**1.04 CLOSEOUT SUBMITTALS**

- A. Refer to Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for pre-functional checklists, equipment startup reports, and other commissioning documents.
- B. Pre-Functional Checklists:
  - 1. Complete pre-functional checklists provided by commissioning agent to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing.
  - 2. Submit completed checklists to COR and to Commissioning Agent. Commissioning Agent can spot check a sample of completed checklists. If Commissioning Agent determines that information provided on the checklist is not accurate, Commissioning Agent then returns the marked-up checklist to Contractor for correction and resubmission.

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3. If Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, Commissioning Agent can select a broader sample of checklists for review.
  4. If Commissioning Agent determines that a significant number of broader sample of checklists is also inaccurate, all checklists for the type of equipment will be returned to Contractor for correction and resubmission.
- C. Submit training agendas and trainer resumes in accordance with requirements of Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.01 FIELD QUALITY CONTROL**

- A. Contractor's Tests:
1. Scheduled tests required by other sections of Division 27 must be documented in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
  2. Incorporate all testing into project schedule. Provide minimum seven calendar days' notice of testing for Commissioning Agent to witness selected Contractor tests at sole discretion of Commissioning Agent.
  3. Complete tests prior to scheduling Systems Functional Performance Testing.
- B. Systems Functional Performance Testing:
1. Commissioning process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions.
  2. Commissioning Agent prepares detailed Systems Functional Performance Test procedures for review and acceptance by COR.
  3. Provide required labor, materials, and test equipment identified in test procedure to perform tests.
  4. Commissioning Agent must witness and document the testing.
    - a. Provide test reports to Commissioning Agent. Commissioning Agent will sign test reports to verify tests were performed.

**3.02 TRAINING**

- A. Training of Government's operation and maintenance personnel is required in cooperation with COR and Commissioning Agent.
- B. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning location, operation, and troubleshooting of installed systems.
- C. Schedule instruction in coordination with COR after submission and approval of formal training plans.

**END OF SECTION**

**SECTION 271000**  
**CONTROL, COMMUNICATION AND SIGNAL WIRING**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

- A. This section includes control, communication and signal wiring for a comprehensive systems infrastructure.
- B. This section applies to all sections of Divisions 27 and 28.

**1.02 RELATED WORK**

- A. Excavation and backfill for cables that are installed in conduit: Section 31 20 00, EARTH MOVING.
- B. Sealing around penetrations to maintain integrity of time rated construction: Section 07 84 00, FIRESTOPPING.
- C. General electrical requirements that are common to more than one section in Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- D. Conduits for cables and wiring: Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- E. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

**1.03 SUBMITTALS**

- A. Submit in accordance with Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- B. Submit written certification from OEM:
  - 1. Indicate wiring and connection diagrams meet National and Government Life Safety Guidelines, NFPA, NEC, NRTL, Joint Commission, OEM, this section and Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
  - 2. Include instructions, requirements, recommendations, and guidance for proper performance of system as described herein.
  - 3. Government will not approve any submittal without this certification.
- C. Identify environmental specifications on technical submittals; identify requirements for installation.
  - 1. Minimum floor space and ceiling heights.
  - 2. Minimum size of doors for cable reel passage.
- D. Power: Provide specific voltage, amperage, phases, // generator equipment // and quantities of circuits.
- E. Provide conduit size requirements.
- F. Closeout Submittals:
  - 1. Provide contact information for maintenance personnel to contact contractor for emergency maintenance and logistic assistance, and assistance in resolving technical problems at any time during warranty period.
  - 2. Provide certified OEM sweep test tags from each cable reel to COR.
  - 3. Furnish spare or unused wire and cable with appropriate connectors (female types) for installation in appropriate punch blocks, barrier strips, patch, or bulkhead connector panels.
  - 4. Turn over unused and opened installation kit boxes, coaxial, fiber optic, and twisted pair cable reels, conduit, cable tray, cable duct bundles, wire rolls, physical installation hardware to COR.

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5. Documentation: Include any item or quantity of items, as installed drawings, equipment, maintenance, and operation manuals, and OEM materials needed to completely and correctly provide system documentation required herein.

**PART 2 PRODUCTS**

**2.01 CONTROL WIRING**

- A. Provide control wiring large enough so voltage drop under in-rush conditions does not adversely affect operation of controls.
- B. Provide cable meeting specifications for type of cable.
- C. Outside Location (i.e. above ground, underground in conduit, ducts, pathways, etc.): Provide cables filled with a waterproofing compound between outside jacket (not touching any provided armor) and inter conductors to seal punctures in jacket and protect conductors from moisture.
- D. Remote Control Cable:
  1. Multi-conductor with stranded conductors able to handle power and voltage required to control specified system equipment, from a remote location.
  2. NRTL listed and pass VW-1 vertical wire flame test (UL 83) (formerly FR-1).
  3. Color-coded Conductors: Combined multi-conductor and coaxial cables are acceptable for this installation, on condition system performance standards are met.
  4. Technical Characteristics:
    - a. Length: As required, in 1K (3,000 ft.) reels minimum.
    - b. Connectors: As required by system design.
    - c. Size:
      - 1) 18 AWG, minimum, Outside.
      - 2) 20 AWG, minimum, Inside.
    - d. Color Coding: Required, EIA industry standard.
    - e. Bend Radius: 10 times cable outside diameter.
    - f. Impedance: As required.
    - g. Shield Coverage: As required by OEM specification.
    - h. Attenuation:

Frequency in MHz	dB per 305 Meter (1,000 feet), maximum
0.7	5.2
1.0	6.5
4.0	14.0
8.0	19.0
16.0	26.0
20.0	29.0
25.0	33.0
31.0	36.0
50.0	52.0

- E. Distribution System Signal Wires and Cables:
  1. Provide in same manner, and use construction practices, as Fire Protective and other Emergency Systems identified and defined in NFPA 101, Life Safety Code, Chapters 7, 12, and 13, NFPA 70, National Electrical Code, Chapter 7, Special Conditions.
  2. Provide system able to withstand adverse environmental conditions without deterioration, in their respective location.
  3. Provide entering of each equipment enclosure, console, cabinet or rack in such a manner that all doors or access panels can be opened and closed without removal or disruption of cables.
  4. Terminate on an item of equipment by direct connection.

## 2.02 COMMUNICATION AND SIGNAL WIRING

- A. Provide communications and signal wiring conforming to recommendations of manufacturers of systems; provide not less than TIA Performance Category 6.
- B. Wiring shown is for typical systems; provide wiring as required for systems being provided.
- C. Provide color-coded conductor insulation for multi-conductor cables.
- D. Connectors:
  - 1. Provide connectors for transmission lines, and signal extensions to maintain uninterrupted continuity, ensure effective connection, and preserve uniform polarity between all points in system.
    - a. Provide AC barrier strips with a protective cover to prevent accidental contact with wires carrying live AC current.
    - b. Provide punch blocks for signal connection, not AC power. AC power twist-on wire connectors are not permitted for signal wire terminations.
  - 2. Cables: Provide connectors designed for specific size cable and conductors being installed with OEM's approved installation tool. Typical system cable connectors include:
    - a. Audio spade lug.
    - b. Punch block.
    - c. Wirewrap.

## 2.03 INSTALLATION KIT

- A. Include connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks or wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, conduit, cable duct, cable tray, etc., required to accomplish a neat and secure installation.
- B. Terminate conductors in a spade lug and barrier strip, wire wrap terminal or punch block, so there are no unfinished or unlabeled wire connections.
- C. Minimum required installation sub-kits:
  - 1. System Grounding:
    - a. Provide required cable and installation hardware for effective ground path, including the following:
      - 1) Control Cable Shields.
      - 2) Data Cable Shields.
      - 3) Equipment Racks.
      - 4) Equipment Cabinets.
      - 5) Conduits.
      - 6) Ducts.
      - 7) Cable Trays.
      - 8) Power Panels.
      - 9) Connector Panels.
      - 10) Grounding Blocks.
    - b. Bond radio equipment to earth ground via internal building wiring, according to NEC.
  - 2. Wire and Cable: Provide connectors and terminals, punch blocks, tie wraps, hangers, clamps, labels, etc. required to accomplish termination in an orderly installation.
  - 3. Conduit, Cable Duct, and Cable Tray: Provide conduit, duct, trays, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat and secure conduit, cable duct, cable tray installation in accordance with NEC and documents.
  - 4. Equipment Interface: Provide any items or quantity of equipment, cable, mounting hardware and materials to interface systems with identified sub-systems, according to OEM requirements and construction documents.
  - 5. Labels: Provide any item or quantity of labels, tools, stencils, and materials to label each subsystem according to OEM requirements, as-installed drawings, and construction

documents.

- D. Cross-Connection System (CCS) Equipment Breakout, Termination Connector (or Bulkhead), and Patch Panels:
1. Connector Panels: Flat smooth 3.175 mm (1/8 inch) thick solid aluminum, custom designed, fitted and installed in cabinet. Install bulkhead equipment connectors on panel to enable cabinet equipment's signal, control, and coaxial cables to be connected through panel. Match panel color to cabinet installed.
    - a. Voice (or Telephone):
      - 1) Provide industry standard Type 110 (minimum) punch blocks for voice or telephone, and control wiring instead of patch panels, each being certified for Category 6.
      - 2) IDC punch blocks (with internal RJ45 jacks) are acceptable for use in CCS when designed for Category 6 and the size and type of cable used.
      - 3) Secure punch block strips to OEM designed physical anchoring unit on a wall location in TRS; console, cabinet, rail, panel, etc. mounting is permitted at OEM recommendation and as accepted by COR. Punch blocks are not permitted for Class II or 120 VAC power wiring.
      - 4) Technical Characteristics:
        - (a) Number of Horizontal Rows: Minimum 100.
        - (b) Number of Terminals per Row: Minimum 4.
        - (c) Terminal Protector: Required for each used or unused terminal.
        - (d) Insulation Splicing: Required between each row of terminals.
    - b. Digital or High Speed Data:
      - 1) Provide 480 mm (19 inches) horizontal EIA/ECA 310 rack mountable patch panel with EIA/ECA 310 standard spaced vertical mounting holes for digital or high-speed data service CSS, with modular female Category 5E (or on a case by case basis Category 6 for specialized powered systems accepted by SMCS 005OP2H3, (202) 461-5310, OI&T and FMS Services, and COR) RJ45 jacks designed for size and type of UTP or F/UTP cable installed in rows.
      - 2) Technical Characteristics:
        - (a) Number of Horizontal Rows: Minimum 2.
        - (b) Number of Jacks Per Row: Minimum 24.
        - (c) Type of Jacks: RJ45.
        - (d) Terminal Protector: Required for each used or unused jack.
        - (e) Insulation: Required between each row of jacks.

## 2.04 EXISTING WIRING

- A. Reuse existing wiring only where indicated on plans and accepted by SMCS 005OP2H3.
- B. Only existing wiring that conforms to specifications and applicable codes can be reused; existing wiring that does not meet these requirements cannot be reused and must be removed by contractor.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. General:
  1. Install wiring in cable tray or raceway.
  2. Seal cable entering a building from underground, between wire and conduit where cable exits conduit, with non-hardening approved compound.
  3. Wire Pulling:
    - a. Provide installation equipment that prevents cutting or abrasion of insulation during pulling of cables.
    - b. Use ropes made of nonmetallic material for pulling feeders.

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- c. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached to conductors, as accepted by COR.
  - d. Pull multiple cables into a single conduit together.
- B. Installation in Maintenance or Man holes:
1. Install and support cables in maintenance holes on steel racks with porcelain or equal insulators.
  2. Train cables around maintenance hole walls, but do not bend to a radius less than six times overall cable diameter.
  3. Fireproofing:
    - a. Install fireproofing where low voltage cables are installed in same maintenance holes with high voltage cables; also cover low voltage cables with arc proof and fireproof tape.
    - b. Use tape of same type used for high voltage cables, and apply tape in a single layer, one-half lapped or as recommended by manufacturer. Install tape with coated side towards the cable and extend minimum 25 mm (1 inch) into each duct.
    - c. Secure tape in place by a random wrap of glass cloth tape.
- C. Control, Communication and Signal Wiring Installation:
1. Unless otherwise specified in other sections, provide wiring and connect to equipment/devices to perform required functions as indicated.
  2. Install separate cables for each system so that malfunctions in any system does not affect other systems, except where otherwise required.
  3. Group wires and cables according to service (i.e. AC, grounds, signal, DC, control, etc.); DC, control and signal cables can be included with any group.
  4. Form wires and cables to not change position in group throughout the conduit run. Bundle wires and cables in accepted signal duct, conduit, cable ducts, or cable trays neatly formed, tied off in 600 mm to 900 mm (24 inch to 36 inch) lengths to not change position in group throughout run.
  5. Concealed splices are not allowed.
  6. Separate, organize, bundle, and route wires or cables to restrict EMI, channel crosstalk, or feedback oscillation inside any enclosure.
  7. Looking at any enclosure from the rear (wall mounted enclosures, junction, pull or interface boxes from the front), locate AC power, DC and speaker wires or cables on the left; coaxial, control, microphone and line level audio and data wires or cables, on the right.
  8. Provide ties and fasteners that do not damage or distort wires or cables. Limit spacing between tied points to maximum 150 mm (6 inches).
  9. Install wires or cables outside of buildings in conduit, secured to solid building structures.
  10. Wires or cables must be specifically accepted, on a case by case basis, to be installed outside of conduit. Bundled wires or cables must be tied at minimum 460 mm (18 inches) intervals to a solid building structure; bundled wires or cables must have ultra violet protection and be waterproof (including all connections).
  11. Laying wires or cables directly on roof tops, ladders, drooping down walls, walkways, floors, etc. is not permitted.
  12. Wires or cables installed outside of conduit, cable trays, wireways, cable duct, etc.:
    - a. Only when authorized, can wires or cables be identified and approved to be installed outside of conduit.
    - b. Provide wire or cable rated plenum and OEM certified for use in air plenums.
    - c. Provide wires and cables hidden, protected, fastened and tied at maximum 600 mm (24 inches) intervals, to building structure.
    - d. Provide closer wire or cable fastening intervals to prevent sagging, maintain clearance above suspended ceilings.
    - e. Remove unsightly wiring and cabling from view, and discourage tampering and vandalism.

- f. Sleeve and seal wire or cable runs, not installed in conduit, that penetrate outside building walls, supporting walls, and two hour fire barriers, with an approved fire retardant sealant.

D. AC Power:

1. Bond to ground contractor-installed equipment and identified Government-furnished equipment, to eliminate shock hazards and to minimize ground loops, common mode returns, noise pickup, crosstalk, etc. for total ground resistance of 0.1 Ohm or less.
2. Use of conduit, signal duct or cable trays as system or electrical ground is not permitted; use these items only for dissipation of internally generated static charges (not to be confused with externally generated lightning) that can be applied or generated outside mechanical and physical confines of system to earth ground. Discovery of improper system grounding is grounds to declare system unacceptable and termination of all system acceptance testing.
3. Cabinet Bus: Extend a common ground bus of at least #10 AWG solid copper wire throughout each equipment cabinet and bond to system ground. Provide a separate isolated ground connection from each equipment cabinet ground bus to system ground. Do not tie equipment ground busses together.
4. Equipment: Bond equipment to cabinet bus with copper braid equivalent to at least #12 AWG. Self-grounding equipment enclosures, racks or cabinets, that provide OEM certified functional ground connections through physical contact with installed equipment, are acceptable alternatives.

### 3.02 EQUIPMENT IDENTIFICATION

A. Control, Communication and Signal System Identification:

1. Install a permanent wire marker on each wire at each termination.
2. Identify cables with numbers and letters on the labels corresponding to those on wiring diagrams used for installing systems.
3. Install labels retaining their markings after cleaning.
4. In each maintenance hole (manhole) and handhole, install embossed brass tags to identify system served and function.

B. Labeling:

1. Industry Standard: ANSI/TIA-606-B.
2. Print lettering for voice and data circuits using laser printers or thermal ink transfer process handwritten labels are not acceptable.
3. Cable and Wires (hereinafter referred to as "cable"): Label cables at both ends in accordance with industry standard. Provide permanent labels in contrasting colors. Identify cables matching system Record Wiring Diagrams.
4. Equipment: Permanently labeled system equipment with contrasting plastic laminate or bakelite material. Label system equipment on face of unit corresponding to its source.
5. Conduit, Cable Duct, and Cable Tray: Label conduit, duct and tray, including utilized GFE, with permanent marking devices or spray painted stenciling a minimum of 3 meters (10 ft.) identifying system. Label each enclosure according to this standard.
6. Termination Hardware: Label workstation outlets and patch panel connections using color coded labels with identifiers in accordance with industry standard and Record Wiring Diagrams.

### 3.03 TESTING

- A. Minimum test requirements are for impedance compliance, inductance, capacitance, signal level compliance, opens, shorts, cross talk, noise, and distortion, and split pairs on cables in frequency ranges specified.
- B. Tests required for data cable must be made to confirm operation of this cable at minimum 10 Mega (M) Hertz (Hz) full bandwidth, fully channel loaded and a Bit Error Rate of a minimum of 10<sup>-6</sup> at maximum rate of speed.



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- C. Provide cable installation and test records at acceptance testing to COR and thereafter maintain in facility's telephone switch room.
- D. Record changes (used pair, failed pair, etc.) in these records as change occurs.
- E. Test cables after installation and replace any defective cables.

**END OF SECTION**

**SECTION 271100  
TELECOMMUNICATIONS ROOM FITTINGS**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

- A. This section specifies equipment cabinets, interface enclosures, relay racks, and associated hardware in service provider DEMARC, computer and telecommunications rooms.
- B. Telephone system is defined as an Emergency Critical Care Communication System by the National Fire Protection Association (NFPA). Adhere to Seismic reference standards for systems connecting to or extending telephone system and cabling.

**1.02 RELATED WORK**

- A. General electrical requirements that are common to more than one section in Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- B. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- C. Conduits for cables and wiring: Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- D. Low voltage cabling system infrastructure: Section 27 10 00, CONTROL, COMMUNICATION AND SIGNAL WIRING.
- E. Voice communication switching and routing equipment: Section 27 31 00, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT.
- F. Extension of a voice communication switching and routing system: Section 27 31 31, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT EXTENSION.
- G. Emergency 2-way radio equipment: Section 27 32 41, TWO-WAY RADIO EQUIPMENT AND SYSTEMS.

**1.03 SUBMITTALS**

- A. Submit in accordance with Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATION.
- B. Separate submittal into sections for each subsystem containing the following:
  - 1. Pictorial layouts of each Telecommunications Room and Cross Connection Space (VCCS, and HCCS termination cabinets), each distribution cabinet layout, and TCO as each is expected to be installed and configured.
  - 2. Equipment technical literature detailing electrical and technical characteristics of each item of equipment to be furnished.
- C. Environmental Requirements: Identify environmental specifications for housing system as initial and expanded system configurations.
  - 1. Floor loading for batteries and cabinets.
  - 2. Minimum floor space and ceiling height.
  - 3. Minimum door size for equipment passage.

**PART 2 PRODUCTS**

**2.01 EQUIPMENT AND MATERIALS**

- A. Provide components of cabinet system (cabinet, thermal, cable and power management accessories) from a single manufacturer.
- B. Equipment Standards and Testing:
  - 1. Equipment must be listed by a NRTL where a UL standard is in existence; active and passive equipment must conform with each UL standard in effect for equipment, on the

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submittal date.

2. Each item of electronic equipment must be labeled by a NRTL that warrants equipment has been tested in accordance with, and conforms to specified standards.

C. Equipment Cabinets (Enclosures):

1. Fully enclose and physically secure internally mounted and connected, active and passive equipment.
2. Types of Equipment Enclosures accepted for specific VA Spectrum Management, FMS and OI&T applications in CFM and Facility Projects:

CABINET	FUNCTION
Communications	FMS Special Communications Equipment
Server / Router	OI&T Data/LAN/WAN Equipment
Seismic	Either FMS or OI&T use, specify need
Environmental	Either FMS or OI&T use, specify need

3. Each cabinet to be:
  - a. Provided in head end, MCR, TER, PCR, EMGR, and each TR at a minimum.
  - b. Fabricated with minimum 1.59 mm (16 gauge) steel.
  - c. Provided with manufacturer's standard painted finish in a color accepted by COR with concurrence from FMS Service Chief.
  - d. Mounted on floor or wall .
  - e. Lockable; tubular locks keyed alike. Provide six keys to COR for each cabinet.
  - f. Compliant with facility's SMS card access system.
4. Provide equipment mounting shelves; attach to front and rear mounting rails and allowing equipment to be secured to respective mounting rails.
5. Each enclosure to include:
  - a. Floor or wall mounting.
  - b. Knock out holes for conduit connections or cable entrance.
  - c. Front and rear locking doors; wall mounted cabinets require only front locking door.
  - d. Power outlet strips.
6. Provide quiet ventilation fan with non-disposable locally cleanable air filter.
7. Size each cabinet in order to contain and maintain internal mounted equipment items.
8. Provide OEM's fully assembled unit.
9. Provide OEM assembled side-by-side enclosures in a single unit, at locations requiring more than two enclosures.
10. Provide minimum one cabinet with blank rack space, for additional system expansion equipment.
11. Bond to communications circulating grounding system.
12. Technical Characteristics:
  - a. External:
    - 1) Overall Height:
      - (a) Communications/Server: Maximum 2,184 mm (86 inches).
      - (b) Seismic: Maximum 1,905 mm (75 inches).
    - 2) Overall Depth:
      - (a) Communications/Server: Maximum 914 mm (36 inches).
      - (b) Seismic: Maximum 762 mm (30 inches).
    - 3) Overall Width - All: Maximum 864 mm (34 inches).
  - b. Front Panel Openings:
    - 1) Width:
      - (a) Communications: 482.6 mm (19 inches), per EIA.
      - (b) Server: 483 mm (19 inches), per EIA/ECA 310.
        - (1) 584 mm (23 inches), per EIA/ECA 310.
        - (2) 610 mm (24 inches), per EIA/ECA 310.

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- (3) 762 mm (30 inches), per EIA/ECA 310.
      - (c) Seismic: 483 mm (19 inches), per EIA/ECA 310.
    - 2) Height:
      - (a) Communications/Server: Maximum 2,000 mm (78-3/4 inches or 45 Rack Units [RU]), per EIA/ECA 310.
      - (b) Seismic: Maximum 1,689 mm (66-1/2 inches or 38 RUs, per EIA/ECA 310).
    - c. Heavy Duty Cycle: Maximum 544 kilograms (1,200 pounds) capacity.
    - d. Certification:
      - 1) NRTL (i.e. UL): For communications and server cabinets.
      - 2) Telcordia Technologies: #63-GR-CORE, (2012) for seismic cabinets.
      - 3) Seismic: Provide cabinet OEM constructed to seismic design category.
13. Cabinet Internal Components:
  - a. AC Power:
    - 1) Standard "Quad AC Box":
      - (a) Power capacity: 20 Ampere, single phase, 120 VAC continuous duty.
      - (b) Wire gauge: #12 AWG, solid copper, connected to room's internal AC Power Panel, or as directed by COR.
      - (c) Number of AC power outlets: Minimum 4 receptacles.
      - (d) Enclosure: Fully self-contained, metal 102 mm (4 inch) x 102 mm (4 inches) x 64 mm (2-1/2 inches) with cover
      - (e) Connection: Minimum 25.4 mm (1 inch) conduit connected to room's AC Power Panel, or as directed by COR
      - (f) Number of boxes: One.
      - (g) Compliance: NRTL (i.e. UL); NPFA - 70 (NEC).
  - b. AC Outlet Strips:
    - 1) Power Capacity: 15 Ampere, single phase, 120 VAC continuous duty.
    - 2) Wire Gauge: Minimum #12 AWG, solid copper.
    - 3) Number of AC Power Outlets: Minimum 10 "U" grounded.
    - 4) Enclosure: Fully self-contained; typically metal.
    - 5) Connecting Wire: Minimum 2 m (6 feet) long, with three prong self-grounding AC plug connected to cabinet's internal AC "Quad" box.
    - 6) Number of Strips: 2.
    - 7) Certification: NRTL (i.e. UL).
  - c. AC Power Line Surge Protector and Filter Construction:
    - 1) Input Voltage Range: 120 VAC + 15 percent at 50/60 Hz, single phase.
    - 2) Power Service Capacity: 20 AMP, 120 VAC.
    - 3) Voltage Output Regulation: +5.0 percent, instantaneous of input.
    - 4) Circuit Breaker: 15 AMP; may be self-contained.
    - 5) AC Outlets: Minimum four duplex grounded NEMA 5-20R.
    - 6) Response Time: 5.0 nanosecond.
    - 7) Suppression: Isolate and filter any noise, surge spikes
      - (a) Surge: Minimum 20,000 AMP.
      - (b) Noise:
        - (1) Common: -40 dB.
        - (2) Differential: -45 dB.
    - 8) Clamping Voltage: Minimum 300 V.
    - 9) Enclosure: One; self-contained.
    - 10) Mounting: Internal to cabinet floor or on internal mounting rail shelf, allowing two plugs from two plug strips.
    - 11) AC Power Cord: Required; minimum 1,628 mm (6 feet), three wire (green ground); minimum #14 AWG stranded.
    - 12) Compliance: NRTL (i.e. UL60950-1).

- d. Uninterruptible Power Supply (UPS): Provide each cabinet with an internal UPS which may be combined with surge protector and filter if system's 50 percent expansion requirement is met. Provide at least one hour continuous full load // two hours if working with a //critical// emergency // safety // police// system// uninterruptible system primary AC Power, with a 50 percent // 30 min // 1.0 hour// respectively // reserve capacity, in the event of facility primary or emergency AC power failure.
- 1) UPS to include:
    - (a) On-Off Switch: This function is required to be a part of system's electronic supervision requirements.
    - (b) First/Fast Charge Unit: Must provide clean predicable charge voltage/current. Function is required to be a part of system's electronic supervision requirements.
    - (c) Over Voltage/Current Protect: Cannot short circuit AC power line at any time. This function is required to be a part of system's electronic supervision requirements.
    - (d) Trickle Charge Unit: Must be capable of maintaining a suitable internal battery charge without damaging batteries.
    - (e) Mounting: Provide per OEM's direction.
    - (f) Proper Ventilation: Do not override cabinets' ventilation system.
    - (g) Power Change from AC Input: Accomplish change without interruption to communications link or subsystem being protected. Generate visual and aural alarms in electrical supervision system, local and remote, to annunciating panels via direct connection for trouble indication.
  - 2) Specific requirements for current and surge protection to include:
    - (a) Voltage Protection: Threshold, line to neutral, starts at maximum 200 Volts peak. Transient voltage cannot exceed 330 Volts peak. Furnish documentation on peak clamping Voltage as a function of transient waveform.
    - (b) Peak Power Dissipation: Minimum 35 Joules per phase, as measured for 1.0 millisecond at sub branch panels, 100 Joules per phase at branch panels and 300 Joules per phase at service entrance panels. Typically, power dissipation is 12,000 Watts (W) for 1.0 ms (or 12 Joules). Provide explanation of how ratings were measured or empirically derived.
    - (c) Surge Protector (may be combined with On-Off switch of UPS): Must not short circuit AC power line at any time.
      - (1) Components must be minimum silicon semi-conductors.
      - (2) Secondary stages, if used, may include other types of rugged devices.
      - (3) Indicators: Provide visual device indicating surge suppression component is functioning.
      - (4) Electrical Supervision: Required; must be audible and visual, local and remote to annunciating panels via direct connection for trouble indication.
    - (d) Provide current and surge protection on ancillary equipment.
    - (e) Equip each cabinet with the following:
      - (1) Equipment Mounting Rails (Front & Rear): Fully adjustable internal equipment mounting rails allowing front or rear equipment mounting with pre-drilled EIA/ECA 310-E Standard tapped holes. Support entire equipment by supplementary support in addition to face mounting screws on rails.
      - (2) Cabinet Ground: Stainless steel adjustable, lug connected to cabinet's main structure providing an internal cabinet ground for all installed equipment properly bolted to rail and with ground wire connected.

- (3) Grounding Terminals: A separate mounting hole on equipment mounting rail, with stainless steel connecting bolt bonded by minimum #10 AWG copper wire to cabinet's internal grounding lug.
  14. Ground Interconnection: Bond cabinet's common grounding lug to room's communications circulating ground busbar with a minimum #4 AWG stranded copper wire.
  15. Blank Panels: Provide at every unused rack space.
    - a. Match cabinet color.
    - b. Provide panels of 3 mm (1/8 inch) thick aluminum with vertical dimensions in increments of one rack unit (RMU) or 45 mm (1-3/4 inch) with mounting holes spaced to correspond to EIA/ECA 310-E Standard 483 mm (19 inch) rack dimensions.
    - c. Fill large unused openings with single standard large panel instead of numerous types.
    - d. Leave one blank rack space (RMU), covered with a blank panel, between each item of equipment, for minimum internal air flow.
    - e. Leave 356 mm (14 inches)(8.0 RMU) open space, covered with blank cover panel, for additional expansion equipment.
    - f. Wire Management: System that connects each item of installed equipment to room wire management system.
    - g. Knock-out Holes: Provide for cable entrance/exits via conduits, cable duct/trays.
  16. Audio Monitor Panel: Provide EIA standard for 483 mm (19 inch) cabinet mounting.
    - a. Provide audio monitor panel in upper portion of HE equipment cabinet.
    - b. Technical Characteristics:
      - 1) Monitor Speaker: A permanent magnet, minimum 76 mm (3 inch) diameter, and a monitor volume control.
      - 2) Audio Meter: Easy to read volume unit, (VU) or similar meter with illuminated scale and meter calibrating control.
      - 3) Channel Selector Switch: Six-position (Off, 1, 2, 3, 4, and Spare) that connects monitor speaker and VU meter to selected audio channel.
  17. Trouble Annunciator Panel: Provide trouble annunciator panel in HE cabinet and locations and as shown on drawings compatible with electrical and electronic supervising signals to continuously monitor operating condition for system HE equipment, remote equipment, and interconnecting trunks.
    - a. When system's supervising system detects malfunctioning equipment or trunk line, system must generate an audible and visual signal; provide spare panel.
    - b. Technical Characteristics:
      - 1) Silence Button or Switch: Provide to silence audible signal. Visual signal will continue until supervisory circuit indicating a fault is corrected.
      - 2) Visual Enunciators: Visually show system equipment and trunk-line operating conditions via its supervisory circuit indicating fault condition.
      - 3) Connect each alarm function to report to PCS Console SMS.
- D. Environmental Cabinet:
1. Enclosure must fully contain installed equipment, including electronics, in same manner as standard cabinet. Provide climate control for installed equipment as if they were in a standalone air handling area, regardless of local area air handling capabilities.
  2. Provide an OEM's fully assembled unit enclosure.
  3. If more than two enclosures are required in any system location, provide OEM-assembled enclosures, in a single unit, side-by-side.
  4. Technical Characteristics:
    - a. Environmental Control: Automatic, heating and cooling as required.
    - b. Temperature Conditions (rated at 1,300 W of install equipment heat generation):
      - 1) Internal Range: Maintains 26.67 degree to 37.78 degree C (80 degree to 100 degree f) of internal heat conditions.

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- 2) External Range: Maximum 37.78 degrees + -3.89 degrees C (100 degrees + 25 degrees F).
  - c. Forced Air Unit: Required with non-disposable air filter; unobstructed and uninterrupted.
  - d. Air Conditioning: As required; fully internal mounted.
  - e. Heater: As required; fully internal mounted.
  - f. UPS: Required; fully internal mounted.
  - g. Front Door: Full length, see through, EMI resistant and lockable, keyed alike with 7-pin tubular lock and Police Service SMS card access .
  - h. Rear door: Full length, see through, EMI resistant, and lockable keyed alike with 7-pin tubular lock and Police Service SMS card access .
  - i. Conduit Wiring Entrance: Top or bottom; fully sealed.
  - j. Input Power: Minimum 2 each; maximum 120 VAC at 20A, independent circuit, conduit for fixed or armored cable for moveable installations.
  - k. Dimensions:
    - 1) Height: Maximum 1980 mm (78 inches).
    - 2) Width: Maximum 635 mm (25 inches).
    - 3) Depth: Maximum 965 mm (38 inches).
    - 4) Front Panel Opening: 480 mm (19 inches), w/ EIA/ECA 310 mounting hole spacing.
  - l. Trouble Annunciator Panel: Refer to specific requirements in equipment cabinet.
  - m. Audio Monitor Panel: Refer to specific requirements in equipment cabinet.
- E. Wall Mounted Distribution or System Interface Cabinet:
1. Construct of minimum 1.59 mm (16 gauge) cold rolled steel, with top, side and bottom panels.
  2. Provide double-hinged front door and main cabinet body allowing access to all internal equipment and wiring; mount to solid walls or internal studs.
  3. Provide baked-on iron phosphate primer and baked enamel paint finish in a color to be selected by the using FMS Chief or COR.
  4. Provide integral and adjustable EIA/ECA 310 standard predrilled rack mounting rails to allow front panel equipment mounting and access.
  5. After equipment, doors and panels are installed, snap-in-place chrome trim strip covers all front panel screw fasteners.
  6. Provide full-length vertical piano hinge to allow entire front portion of cabinet to "swing out" from wall for access to installed equipment, wires and cable; maintain minimum OSHA Safety clearances and NFPA operational functions.
  7. Provide an OEM's fully assembled unit enclosure.
  8. Equip these cabinets same as equipment cabinets, except mount UPS on floor below cabinet with AC power connection in conduit to AC service panel.
  9. Technical Characteristics:
    - a. Overall Height: Maximum 1,218 mm (48 inches).
    - b. Overall Depth: Maximum 558 mm (22 inches).
    - c. Overall Width: Maximum 610 mm (24 inches).
    - d. Front Panel Horizontal: Maximum width 483 mm (19 inches).
    - e. Capacity: Maximum 180 kilograms (400 pounds).
    - f. Lockable:
      - 1) Tubular lock with 7-pin security.
      - 2) Key cabinets alike.
      - 3) Police SMS access card system. /
- F. Stand Alone Open Equipment Rack:
1. Construct of minimum 1.59 mm (16 gauge) cold rolled steel with manufacturer's standard paint finish, in a color to be selected by COR with concurrence from facility's FMS Service

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- Chief.
- 2. Floor-mount as directed by COR with concurrence from facility's FMS Service Chief.
- 3. Equip rack same as equipment cabinet, except mount UPS with additional support for weight and AC power connection in conduit to AC service panel.
- 4. Provide an OEM fully assembled unit.
- 5. Technical Characteristics:
  - a. Overall Height: Maximum 2,180 mm (85-7/8 inches).
  - b. Overall Depth: Maximum 650 mm (25-1/2 inches).
  - c. Overall Width: Maximum 535 mm (21-1/16 inches).
  - d. Front Panel Opening: 483 mm (19 inches), EIA/ECA 310 horizontal width.
  - e. Hole Spacing: Per EIA/ECA 310.
  - f. Load Capacity: Maximum 680.4 kg (1,500 lbs).
  - g. Certifications:
    - 1) EIA/ECA: 310-E.
    - 2) NRTL (i.e. UL): OEM specific.
- G. Wire Management Equipment:
  - 1. Provide an orderly horizontal and vertical interface between outside and inside wires and cables, distribution and interface wires and cables, interconnection wires and cables and associated equipment, jumper cables, and provide a uniform connection media for system fire-retardant wires and cables and other subsystems.
  - 2. Interface to each cable tray, duct, wireway, or conduit used in the system.
  - 3. Interconnection or distribution wires and cables must enter system at top (or from a wireway in the floor) via overhead protection system and be uniformly routed down // either or // both sides at same time, of the frames side protection system, then laterally for termination on rear of each respective terminating assembly.
  - 4. Custom configure to meet 30 percent fill system design and user needs.
- H. Vertical Cable Managers:
  - 1. Use same make, style and size of vertical cable manager on rack/frame or in between racks/frames when more than one cable manager is used on a rack/frame or group of racks/frames.
  - 2. Match color and cover style of racks/frames and cable managers.
- I. Horizontal Cable Managers:
  - 1. Use same make and style of cable manager on rack/frame or racks/frames, when more than one horizontal cable manager is used on a rack/frame or group of racks/frames.
  - 2. Match color of racks/frames and cable managers.
- J. Telecommunication Room (TR): In hostile TR locations identified on drawings, where it has been determined (by COR or Facility Chief Engineer) that proper TR climate or external signal radiation cannot be maintained or controlled, provide a minimum of two individual and properly sized self-contained climate controlled equipment cabinet enclosures; one designated for voice, // and // one designated for data // , and one additional cabinet designated for analog RF // service.
- K. Provide gas protection devices on all circuits and cable pairs serving building distribution frames, located in buildings other than building in which // \_\_\_\_\_ // is located, or in any area served by an unprotected distribution system (maintenance hole, manhole, aerial, etc.).
- L. Provide installation hardware when enclosures or racks are attached to structural floor.
- M. Provide noise filters and surge protectors for each equipment interface cabinet, switch equipment cabinet, control console, and local and remote active equipment locations to ensure protection from input primary AC power surges so as a consequence noise glitches are not induced into low voltage data circuits.



## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Coordinate cabinet installation such that doors fully close and lock, with active and passive equipment installed and connected.
- B. Verify equipment dimensions and brackets allow mounting with cabinet doors closed. Front door or rear door of any cabinet that does not close and lock may result in immediate cancellation of inspections or tests.

### **3.02 INSTALLATION**

- A. Equipment Cabinets:
  - 1. Install cabinets in a manner that complies with OEM instructions, requirements of this specification, and in a manner which does not constitute a safety hazard.
  - 2. Provide weatherproof equipment installed outdoors or install in NEMA 3S rated enclosures with hinged doors and locks with two keys.
  - 3. Install equipment indoors in NEMA 4 rated metal cabinets with hinged doors and locks with two keys.
- B. Grounding:
  - 1. Bond equipment, including identified Government furnished equipment, to ground so total ground resistance measures maximum 0.1 Ohm.
    - a. Install lightning arrestors and grounding in accordance with NFPA.
    - b. Install gas protection devices at nearest point of entrance in buildings where protection is required and on same circuits as MDF in telephone switch room.
    - c. Do not use AC neutral, including in power panel or receptacle outlet, for system control, subcarrier or audio reference ground.
    - d. Use of conduit, signal duct or cable trays as system or electrical ground is not permitted.
  - 2. Connect each equipment grounding terminal to a separate mounting hole on equipment mounting rail, to right as one looks at it from rear, with a minimum #12 AWG stranded copper wire with protective green jacket.
  - 3. Extend common ground bus of minimum #10 AWG solid copper wire throughout each equipment cabinet and bond to TGB. Provide a separate isolated ground connection from each equipment cabinet ground bus to system ground. Do not tie equipment ground buses together.
  - 4. Bond equipment to cabinet bus with copper braid equivalent to #12 AWG. Self-grounding equipment enclosures, racks or cabinets, that provide OEM certified functional ground connections through physical contact with installed equipment, are acceptable alternatives.
  - 5. Bond cable shields to cabinet ground bus with minimum #12 AWG stranded copper wire at only one end of cable run. Insulate cable shields from each other, faceplates, equipment racks, consoles, enclosures or cabinets, except at system common ground point. Bond coaxial and audio cables only at source; in all cases, keep cable shield ground connections to a minimum.
- C. Equipment Assembly:
  - 1. Cabinets:
    - a. Install and adjust cabinet/frame accessories to position, including thermal management accessories, vertical cable managers, vertical power managers and equipment-mounting rails, using manufacturer's installation instructions prior to buying or placing cabinet for attachment to building and before installing any rack-mount equipment into cabinet. Shelves, horizontal cable managers and filler panels (rack-mount accessories), if used, may be installed after cabinet is placed.
    - b. When used in a multi-cabinet bay, attach cabinets side-by-side using buying kits according to manufacturer's instructions.

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- c. Attach overhead ladder rack or cable tray to ceiling or top of cabinet. Maintain minimum 75 mm (3 inches) clearance between top of cabinet and bottom of ladder rack/cable tray. Position ladder rack/cable tray so that it does not interfere with hot air exhaust through cabinet's top panel. Use radius drops where cable enters or exits ladder rack/cable tray.
  - d. // In seismic areas, install additional bracing as required by building codes and recommendations of a licensed structural engineer. //
  - e. Install ladder rack with side stringers facing rack or cabinet so that ladder forms an inverted U-shape and so that welds between stringers (sides) and cross members (middle) face away from cables.
  - f. Secure ladder rack to tops of equipment racks or cabinets using manufacturer's recommended supports and appropriate hardware.
  - g. Attach bonding conductor sized per TIA-607-B between telecommunications grounding busbar and cabinet. Attach bonding conductor to cabinet using a ground terminal block according to manufacturer's installation instructions.
  - h. Provide bonding conductor and other hardware required to make connections between cabinet and telecommunications grounding busbar.
  - i. Install rack mounted equipment normally requiring adjustment or observation so operational adjustments can be conveniently made.
  - j. Mount heavy equipment with rack slides or rails to allow servicing from front of enclosure. Provide support in addition to front panel mounting screws for heavy equipment.
  - k. Provide with cable slack to permit servicing by removal of installed equipment from front of enclosure.
  - l. Install color-matched blank panel spacer 44 mm (1.75 inches) high between each piece of active and passive equipment to ensure adequate air circulation for efficient equipment cooling and air ventilation.
  - m. Provide quiet fans and non-disposable air filters at each console or cabinet.
  - n. Install enclosures and racks plumb and square, permanently attached to building structure and held in place.
  - o. Provide 381 mm (15 inches) of front vertical space opening for additional equipment.
  - p. Install equipment located indoors in metal racks or enclosures with hinged doors to allow access for maintenance without causing interference to other nearby equipment.
  - q. Cables must enter equipment racks or enclosures in such a manner to allow doors or access panels to open and close without disturbing or damaging cables.
  - r. Mount distribution hardware in a manner that allows access to connections for testing and provides room for doors or access panels to open and close without disturbing the cables.
2. Racks:
- a. Assemble racks according to manufacturer's instructions.
  - b. Verify that equipment mounting rails are sized properly for rack-mount equipment before attaching rack to floor.
  - c. Attach assembled racks to floor in four places using appropriate floor mounting anchors. When placed over a raised floor, threaded rods should pass through raised floor tile and be secured in structural floor below.
  - d. Bond racks to telecommunications grounding busbar using appropriate hardware provided by contractor.
  - e. //In seismic areas, install additional bracing as required by building codes and recommendations of a licensed structural engineer. //
  - f. Ladder rack may be attached to top of rack to deliver cables to rack. Do not drill rack to attach; use appropriate hardware from rack manufacturer.

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- g. Provide radius drops to guide cable where cable exits or enters side of overhead ladder rack to access a rack, frame, cabinet or wall-mounted rack, cabinet or termination field.
  - h. Evenly distribute equipment load on rack. Place large and heavy equipment towards bottom of rack. Secure equipment to rack with equipment mounting screws. // In seismic areas, secure equipment to shelves with additional bracing. //
3. Vertical Cable Managers:
- a. Provide vertical managers so number of cables in each manager does not exceed OEM fill capacity.
  - b. Attach vertical cable managers to side of rack/frame using manufacturer's installation instructions and hardware.
  - c. Attach vertical cable manager to both racks/frames when a single vertical cable manager is used between two racks/frames.
  - d. Dress cables through openings in between T-shaped guides on manager so that cables make gradual bends as they exit or enter cable manager into rack-mount space (RMU). Do not twist, coil or make sharp bends in cables.
  - e. Attach doors to cable manager in closed position after cabling is complete.
4. Horizontal Cable Managers:
- a. Attach horizontal cable managers to rack/frame with minimum four screws according to manufacturer's installation instructions. Center each cable manager within allocated rack-mount space (RMU).
  - b. Provide horizontal managers located so number of cables each manager supports is less than cable manager's cable fill capacity.
  - c. Dress cables through openings in between T-shaped guides on cable manager so that cables make gradual bends as they exit or enter cable manager into rack-mount space (RMU). Do not twist, coil or make sharp bends in cables.
  - d. Attach covers to cable manager in closed position after cabling is complete.
- D. Labeling: Permanently label each enclosure in accordance with TIA-606-B using laser printers or thermal ink transfer process; handwritten labels are not acceptable.
- 1. Equipment: Label system equipment with contrasting plastic laminate or bakelite material on face of unit corresponding to its source.
  - 2. Conduit, Cable Duct, and/or Cable Tray: Label conduit, duct and tray, including utilized GFE, with permanent marking devices or spray painted stenciling a minimum of 3 m (10 feet), identifying system.

**END OF SECTION**

**SECTION 271500**  
**COMMUNICATIONS STRUCTURED CABLING**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

- A. This section specifies a complete and operating voice and digital structured cabling distribution system and associated equipment and hardware to be installed in VA Medical Center, hereinafter referred to as the "facility".

**1.02 RELATED WORK**

- A. General electrical requirements that are common to more than one section in Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- B. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- C. Conduits for cables and wiring: Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- D. Low voltage cabling system infrastructure: Section 27 10 00, CONTROL, COMMUNICATION AND SIGNAL WIRING.
- E. Voice communication switching and routing equipment: Section 27 31 00, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT.
- F. Extension of a voice communication switching and routing system: Section 27 31 31, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT EXTENSION.
- G. Emergency radio equipment: Section 27 32 41, TWO-WAY RADIO EQUIPMENT AND SYSTEMS.
- H. High Definition (HDTV) Master Antenna Television (MATV) system and associated equipment: Section 27 41 31, MASTER ANTENNA TELEVISION EQUIPMENT AND SYSTEMS.
- I. Emergency Service Public Address System (PAS) and associated equipment: Section 27 51 16, PUBLIC ADDRESS AND MASS NOTIFICATION SYSTEMS.

**1.03 SUBMITTALS**

- A. In addition to requirements of Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS provide:
  - 1. Pictorial layout drawing of each // main computer room, // voice (telephone) equipment room, // network operations room, // antenna headend equipment room, // Demarc room, // telecommunications room, // voice (telephone) operators room // showing termination cabinets, each distribution cabinet and rack, as each is expected to be installed and configured.
  - 2. List of test equipment as per 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- B. Certifications:
  - 1. Submit written certification from OEM indicating that proposed supervisor of installation and proposed provider of contract maintenance are authorized representatives of OEM. Include individual's legal name and address and OEM warranty credentials in the certification.
  - 2. Pre-acceptance Certification: Submit in accordance with test procedures.
  - 3. Test system cables and certify to COR before proof of performance testing can be conducted. Identify each cable as labeled on as-installed drawings.
  - 4. Provide current and qualified test equipment OEM training certificates and product OEM installation certification for contractor installation, maintenance, and supervisory personnel.

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- C. Closeout Submittal: Provide document from OEM certifying that each item of equipment installed conforms to OEM published specifications.

#### 1.04 WARRANTY

- A. Work subject to terms of Article "Warranty of Construction," FAR clause 52.246-21.

### PART 2 PRODUCTS

#### 2.01 PERFORMANCE AND DESIGN CRITERIA

- A. Provide complete system including "punch down" and cross-connector blocks voice and data distribution sub-systems, and associated hardware including telecommunications outlets (TCO); copper and fiber optic distribution cables, connectors, "patch" cables, "break out" devices and equipment cabinets, interface cabinets, and radio relay equipment rack.
- B. Industry Standards:
1. Cable distribution systems provided under this section are connected to systems identified as critical care performing life support functions.
  2. Conform to National and Local Life Safety Codes (whichever are more stringent), NFPA, NEC, this section, Joint Commission Life Safety Accreditation requirements, and OEM recommendations, instructions, and guidelines.
  3. Provide supplies and materials listed by a nationally recognized testing laboratory where such standards are established for supplies, materials or equipment.
  4. Refer to industry standards and minimum requirements of Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS and guidelines listed.
  5. Active and passive equipment required by system design and approved technical submittal; must conform to each UL standard in effect for equipment, when technical submittal was reviewed and approved by Government or date when COR accepted system equipment to be replaced. Where a UL standard is in existence for equipment to be used in completion of this contract, equipment must bear approved NRTL label.
- C. System Performance: Provide complete system to meet or exceed TIA Category 6 requirements.
- D. Provide continuous inter- and/or intra-facility voice, data, and analog service.
1. Provide voice and data cable distribution system based on a physical "Star" topology.
  2. Provide separate cable distribution system for emergency, safety and protection systems (i.e. emergency bypass phones; police emergency voice communications from parking lots and stairwells personal protection, duress alarms and annunciation systems; etc.)
  3. Contact SMCS 005OP2H3 (202-462-5310) for specific technical assistance and approvals.
- E. Specific Subsystem Requirements: Provide products necessary for a complete and functional voice, data, analog and video telecommunications cabling system, including backbone cabling system, patch panels and cross-connections, horizontal cabling systems, jacks, faceplates, and patch cords.
- F. Coordinate size and type of conduit, pathways and firestopping for maximum 40 percent cable fill with subcontractors.
- G. Terminate all interconnecting twisted pair, fiber-optic or coaxial cables on patch panels or punch blocks. Terminate unused or spare conductors and fiber strands. Do not leave unused or spare twisted pair wire, fiber-optic or coaxial cable unterminated, unconnected, loose or unsecured.
- H. Color code distribution wiring to conform to ANSI/TIA 606-B and construction documents, whichever is more stringent. Label all equipment, conduit, enclosures, jacks, and cables on record drawings, to facilitate installation and maintenance.
- I. In addition to requirements in Section 27 05 11, REQUIREMENTS FOR COMMUNICATION INSTALLATIONS, provide stainless steel faceplates with plastic covers over labels.

## 2.02 EQUIPMENT AND MATERIALS

- A. Where system connects to an existing or future voice (telephone) system, refer to Section 27 31 00, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT or Section 27 31 31, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT - EXTENSION for specific voice (telephone) equipment and system operational performance standards.
- B. Cable Systems - Twisted Pair, Fiber optic, Coaxial and Analog:
  - 1. General:
    - a. Provide cable (i.e. backbone, outside plant, and horizontal cabling) conforming to accepted industry standards with regards to size, color code, and insulation.
    - b. Some areas can be considered "plenum". Comply with all codes pertaining to plenum environments. It is contractor's responsibility to review the VA's cable requirements with COR and OI&T Service prior to installation to confirm type of environment present at each location.
    - c. Provide proper test equipment to confirm that cable pairs meet each OEM's standard transmission requirements, and ensure cable carries data transmissions at required speeds, frequencies, and fully loaded bandwidth.
  - 2. Telecommunications Rooms (TR):
    - a. In TR's served with UTP // and STP // fiber optic, coaxial and analog backbone cables, terminate UTP // and STP // cable on RJ-45, 8-pin connectors of separate 48-port modular patch panels, //110A or equivalent type punch down blocks that are dedicated to voice and data applications//.
    - b. Provide 24 port fiber optic modular patch panels with "LC" // or OEM specified // couplers dedicated for voice, data and FMS applications.
    - c. Provide connecting cables required to extend backbone cables (i.e. patch cords, twenty-five pair, etc.), to ensure complete and operational distribution systems.
    - d. In TR's, which are only served by a UTP // and STP // backbone cable, terminate cable on separate modular connecting devices, Type 110A punch down blocks (or equivalent), dedicated to data applications.
  - 3. Backbone Copper Cables:
    - a. Riser Cable:
      - 1) Provide communication riser cables listed in NEC Table 800, 154(a) for the purpose and suited for electrical connection to a communication network.
      - 2) Provide STP or Unshielded Twisted Pair (UTP), minimum 24 American Wire Gauge (AWG) solid, thermoplastic insulated conductors for communication (analog RF coaxial cable is not to be provided in riser systems) riser cables with a thermoplastic outer jacket.
      - 3) Label and test complete riser cabling system.
  - 4. Horizontal Cable: Installed from TCO jack to the TR patch panel.
    - a. Tested to ANSI/TIA-568-C.2 Category 6 requirements including NEXT, ELFEXT (Pair-to-Pair and Power Sum), Insertion Loss (attenuation), Return Loss, and Delay Skew.
    - b. Minimum Transmission Parameters: // 250 MHz //500 MHz//.
    - c. Provide four pair // 0.205 mm<sup>2</sup> (24 AWG) // 0.326 mm<sup>2</sup> (22 AWG) // cable
    - d. Terminate all four pairs on same port at patch panel in TR.
    - e. Terminate all four pairs on same jack, at work area Telecommunication Outlets (TCO):
      - 1) Jacks: Minimum three eight-pin RJ-45 ANSI/TIA-568-C.2 Category 6 Type jacks at TCO.
        - (a) Top Port: RJ-45 jack compatible with RJ-11 plug for voice.
        - (b) Bottom Two Ports: Unkeyed RJ-45 jacks for data.
  - 5. Patient Bedside Prefabricated Units (PBPU):

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- a. Where PBPU's exist in facility, identify single gang "box" location on PBPU designated for installation of TCO; obtain written approval and specific instructions from PBPU OEM regarding disassembly and reassembly of each PBPU to extent necessary to install cable to PBPU box reserved for TCO.
- b. Provide stainless steel face plate approved for use by PBPU OEM and COR.
6. Fiber Optics Backbone Cable:
  - a. Provide 50/125 // 62.5/125 (for Bell System Interconnection Compatibility // micron OM4 multi-mode cable, containing at minimum 18 strands of fiber, unless otherwise specified.
  - b. Provide loose tube cable, which separates individual fibers from the environment, or indoor/outdoor cables, for outdoor runs or any area that includes an outdoor run.
  - c. Provide tight buffered fiber cable or indoor/outdoor cables for indoor runs.
  - d. Terminate multimode fibers at both ends with LC // SC // type female connectors installed in an appropriate patch or breakout panel and secured with a cable management system. Provide minimum 610 mm (2 ft.) cable loop at each end.
  - e. Provide single mode fiber optic cable 8.3 mm containing at minimum 12 strands of fiber, unless otherwise specified. Terminate single mode fibers at both ends with LC SC type female connectors installed in an appropriate patch or breakout panel and secured with a cable management system. Provide minimum 610 mm (2 feet) cable loop at each end to allow for future movement.
  - f. Install fiber optic cables in TR's, Voice (Telephone) Switch Room, and Main Computer Room, in rack mounted fiber optic patch panels. Provide female LC // SC // couplers in appropriate panel for termination of each strand.
  - g. Test all fiber optic strands' cable transmission performance in accordance with TIA standards. Measure attenuation in accordance with fiber optic test procedures TIA-455-C ('-61', or -53). Provide written results to COR for review and approval.
- C. Cross-Connect Systems (CCS):
  1. Copper Cables: Provide copper CCS sized to connect cables at TR and allow for a minimum of 50 percent anticipated growth.
  2. Maximum DC Resistance per Cable Pair: 28.6 Ohms per 305 m (1,000 feet).
  3. Fiber Optic Cables:
    - a. Provide fiber CCS sized to connect cables at TR and allow for a minimum of 50 percent anticipated growth.
    - b. Install fiber optic cable slack in protective enclosures.
- D. Telecommunication Room (TR):
  1. Terminate backbone and horizontal, copper, fiber optic, coaxial and analog cables on appropriate cross-connection systems (CCS) containing patch panels, punch blocks, and breakout devices provided in enclosures and tested, regardless of installation method, mounting, termination, or cross-connecting used. Provide cable management system as a part of each CCS.
  2. Coordinate location in TR with FMS equipment (i.e. fire alarm, nurse call, code blue, video, public address, radio entertainment, intercom, and radio paging equipment).
- E. Coaxial and Analog Cables: Bond equipment to ground per TIA standards, such that all grounding systems comply with all applicable National, Regional, and Local Building and Electrical codes.
  1. Provide current arrester for each copper or coaxial cable that enters from outside of a building regardless if cable is installed underground or aerial.
  2. Provide a gas surge protector/module and bond to earth ground.
- F. Main Cross-connection Subsystem (MCCS): MCCS is common point of distribution for inter- and intra-building copper and fiber optic backbone system cables, and connections to the voice (telephone) and data cable systems.
- G. Voice (or Telephone) Cable Cross-Connection Subsystem:

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1. Provide Insulation Displacement Connection (IDC) hardware.
  2. Provide the following for each Category 5E (or on a case by case basis Category 6 for specialized powered systems technically accepted by SMCS 005OP2H3, (202) 461-5310, OI&T and FMS Services and COR) Cabling System termination; // cross-connection wires, // RJ-45 patch cord connector to RJ-45 patch cord connector // , hybrid modular cord to IDC patch cord connector//.
    - a. Provide terminations to be accessible without need for disassembly of IDC wafer. Provide IDC wafers removable from their mounts to facilitate testing on either side of connector.
    - b. Provide removable designation strips or labels to allow for inspection of terminations.
    - c. Provide cable management system as a part of IDC.
  3. Provide IDC connectors capable of re-terminations, without damage, a minimum of 200 IDC insertions or withdrawals on either side of connector panel.
  4. Install using only non-impact terminating tool having both a tactile and an audible feedback to indicate proper termination.
  5. Provide inputs from // PBX//, FTS, Local Voice (Telephone) System, or diverse routed voice distribution systems on left side of IDC (110A blocks with RJ45 connections are acceptable alternates to IDC) of MCCS.
  6. Provide system outputs from MCCS to voice backbone cable distribution system on the right side of same IDC (or 110A blocks) of MCCS.
  7. Do not split pairs within cables between different jacks or connections.
  8. Provide UTP cross connect wire to connect each pair of terminals plus an additional 50 percent spare.
- H. Data Cross-Connection Subsystems:
1. Provide patch panels with modular RJ45 female to 110 connectors for cross-connection of copper data cable terminations // and system ground // with cable management system.
  2. Provide patch panels conforming to EIA/ECA 310-E dimensions and suitable for mounting in standard equipment racks, with 48 RJ45 jacks aligned in two horizontal rows per panel. Provide RJ45 jacks of modular design and capable of accepting and functioning with other modular (i.e. RJ11) plugs without damaging jack.
    - a. Provide system inputs from servers, data LAN, bridge, or interface distribution systems on top row of jacks of appropriate patch panel.
    - b. Provide backbone cable connections on bottom row of jacks of same patch panel.
    - c. Provide patch cords for each system pair of connection jacks with modular RJ45 connectors provided on each end to match panel's modular RJ45 female jack's being provided.
- I. Fiber-Optic Cross-Connection Subsystems: Provide rack mounted patch or distribution panels installed inside a lockable cabinet or "breakout enclosure" that accommodate minimum 12 strands multimode fiber and 12 strand single mode fiber - these counts do not include 50 percent spare requirement. Provide cable management system for each panel.
1. Provide panels for minimum 24 female LC // SC // connectors, able to accommodate splices and field mountable connectors and have capacity for additional connectors to be added up to OEM's maximum standard panel size for this type of use. Protect patch panel sides, including front and back, by a cabinet or enclosure.
  2. Provide panels that conform to EIA/ECA 310-E dimensions suitable for installation in standard racks, cabinets, and enclosures. // Provide panels for system grounding where armored cables are installed. //
  3. Provide patch panels with highest OEM approved density of fiber LC // SC // termination's (maximum of 72 each), while maintaining a high level of manageability. Provide proper LC // SC // couplers installed for each pair of fiber optic cable LC // SC // connectors.
    - a. Provide system inputs from interface equipment or distribution systems on top row of connectors of appropriate patch panel.



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- b. Provide backbone cable connections on bottom row of connectors of same patch panel.
        - c. Provide patch cords for each pair of fiber optic strands with connector to match couplers.
      4. Provide field installable connectors that are pre-polished.
        - a. Terminate every fiber cable with appropriate connector, and test to ensure compliance to specifications and industry standards for fiber optic LC // SC// female connector terminated with a fiber optic cable.
        - b. Install a terminating cap for each unused LC // SC// connector.
    - J. Copper Outside Plant Cable: Minimum of // STP or // UTP, 22 AWG solid conductors, solid PVC insulation, and filled core (flex gel - waterproof Rural Electric Association (REA) listed PE 39 code) between outer armor or jacket and inner conductors protective lining.
      1. Provide copper cable system as a Star // \_\_\_\_\_ // Topology.
    - K. Horizontal Cabling (HC):
      1. Horizontal cable length to farthest system outlet to be maximum of 90 m (295 ft).
      2. Splitting of pairs within a cable between different jacks is not permitted.
    - L. Air Blown Fiber: Alternative fiber optic cable installation method.
      1. Air blown fiber installation process (also referred to as air blown cable, air assisted cable, high pressure air blowing, cable jetting, and referred to as air blown fiber herein) typically uses separate optical fiber cables along with separate flexible protective microducts installed where optical fiber cables can be blown in using specific equipment, trained installation personnel and practices.
      2. Indoor Microducts:
        - a. Provide empty bundled microducts comprising an inner layer of microducts optimized for air blown fiber system and an outer jacket layer of plenum // riser // //general purpose// rated material with product identification and sequential length marking on outer layer at minimum one-meter (three feet) intervals.
        - b. Provide microduct allowing multiple fibers to be installed simultaneously into each microduct using air blown fiber installation technique and fibers to also be removed from microduct using same technique.
        - c. Size each microduct for 50 percent unoccupied microducts after initial fiber bundle installation.
        - d. Furnish microducts that maintain minimum bend radius of 20 times cable diameter.
        - e. Provide quantity of plugs or end-caps so all unoccupied microducts are plugged on both ends per manufacturer's specifications. Provide plugs or end-caps that can be easily installed or removed from duct connectors as needed over the lifetime of the installation.
      3. Outside Microducts:
        - a. Provide outdoor-rated bundled microducts consisting of a number of empty microducts comprising an inner layer of microducts optimized for air blown fiber system and covered by a rated jacketing material with product identification and sequential length marking on outer layer at one-meter (three feet) minimum intervals.
        - b. Provide microducts with rodent protection at direct buried applications.
        - c. Protect outdoor-rated bundled microducts either by utilizing a moisture barrier and an outer jacket outerlayer of // jacketed, galvanized steel armored (underground), direct buried, or outdoor tray or rack locations // UV resistant for aerial, outdoor rack or tray applications // jacketed, galvanized steel armored for aerial, outdoor rack or tray locations // or by utilizing an HDPE jacket (with optional steel-tape wrapped between outer jacket and inner microducts) that has been treated with rodent deterrent.
        - d. Water-blocking must be accomplished by utilizing a moisture barrier within the bundled microduct assembly or by utilizing water-blocked fiber cable.

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- e. Provide microduct allowing multiple fibers to be installed simultaneously into each microduct using air blown fiber installation technique and fibers to also be removed from microduct using same technique.
  - f. For future capacity, size each microduct provided for 50 percent unoccupied microducts after initial fiber bundle installation.
  - g. Furnish microducts to maintain minimum bend radius twenty times cable diameter.
  - h. Provide quantity of plugs or end-caps so unoccupied microducts are plugged on both ends per manufacturer's specifications, to prevent ingress of contaminants including water.
4. Microduct Couplers: Provide plastic-bodied pneumatic connector to join microducts of same size.
    - a. Provide straight connectors constructed of a transparent plastic material permitting a visual verification of fiber population.
    - b. Provide tee connectors with additional port allowing for gas-blocking in internal/external situations, or provide gas-blocking couplers as needed to protect and isolate classified areas from non-classified areas or provide close-down connectors if needed for midspan assisted blows in long runs
  5. Microduct Distribution Units: Provide NEMA-rated enclosure, suited for site environmental conditions provided for microduct distribution, routing, and termination.
    - a. Provide unit capable of wall mounting to provide proper geometry for distribution wherever several microducts enter same location or where microduct type transitions take place.
    - b. Size based on number of microducts to enter unit.
  6. Outdoor Enclosure/Splice Case: Provide outdoor NEMA-rated enclosure, or splice case suitable for site environmental conditions of outside plant microduct distribution and routing.
    - a. Splice Cases: Water-tight, and air-tight re-enterable splice cases that do not require re-entry kits.
    - b. Material: Stainless steel.
    - c. Select enclosure/splice case hardware to meet site conditions.
      - 1) Provide NEMA-4 and 4X enclosures or splice cases in areas where hosing and splashing environmental conditions exist.
      - 2) Provide NEMA-6 and 6P enclosures splice cases in areas where temporary or long term flooded environmental conditions exist.
  7. Fiber Termination Units: Provide at locations where fiber is to be terminated.
    - a. Provide for strain relief of incoming microducts.
    - b. Provide connector panels and connector couplings adequate to accommodate the number of fibers to be terminated.
    - c. Incorporate radius control mechanisms to limit bending of fibers to manufacturer's recommended minimum or 76 mm (3 inches), whichever is larger.
    - d. Where rack-mount fiber termination hardware is required, provide wall-mount microduct distribution unit near rack and provide individual microducts to route and connect fiber bundle passing through microduct distribution units to fiber termination hardware.
    - e. Provide LC // SC // connectors mounted on a coupler panel that snaps into patch panel housing assembly.
  8. Fiber Bundles or Cables:
    - a. Provide fiber bundles or cables designed and manufactured to facilitate:
      - 1) Rapid installation of fiber using air blown fiber installation process without risk or damage to fibers.
      - 2) Re-installation without degradation of the optical specifications and performance of fiber.
      - 3) Transition points from indoor to outdoor environments without splices.

- b. Provide jacketed optical fibers manufactured so that the jacketed fiber strands meet GR409 and meet either UL 1666 for riser rated cables or UL 910 for plenum rated cables and are specific to the purpose of being blown throughout the bundled microduct system.
- c. Provide fiber designed to be stripped and terminated with standard tools.
- d. Provide fiber designed to be terminated with standard fiber optic connectors.
- e. Provide maximum 72 strands of fiber to be blown within each microduct; if fiber counts higher than 72 strands are required, provide microcore fiber with counts to 432 strands in larger size microducts.

**2.03 DISTRIBUTION EQUIPMENT AND SYSTEMS**

A. Telecommunication Outlet:

- 1. TCO consists of minimum one voice (telephone) RJ45 jack and two data RJ45 jacks//, and one single mode fiber optic //, and one multimode fiber optic jacks // mounted in a separate steel outlet box 100 mm (4 inches) x 100 mm (4 inches) x 63 mm (2-1/2 inches) minimum with a labeled stainless steel faceplate. Where shown on drawings, provide a second steel outlet box minimum 100 mm (4 inches) x 100 mm (4 inches) x 63 mm (2-1/2 inches), with a labeled faceplate, adjacent to first box to ensure system connections and expandability requirements are met.
- 2. Provide RJ-45/11 compatible female type voice (telephone) multi-pin connections. Provide RJ-45 female type data multi-pin connections. // Provide LC // SC // ceramic // stainless steel // ferrule female type fiber optic connectors. //
- 3. Provide wall outlet with a stainless steel face plate and sufficient ports to fit voice (telephone) multi-pin jack, data multi-pin jacks // , fiber optic jacks // , analog jacks // and plastic covers for labels when mounted on outlet box provided (minimum 100mm (4 inches) x 100mm (4 inches) for single and 100mm (4 inches) x 200mm (8 inches) for dual outlet box applications. Install stainless steel face plate, for prefabricated bedside patient unit installations.
- 4. // Interface fiber optic LC // SC// jacks to appropriate patch panels in associated TR, but do not cross-connect fiber optic cables fiber optic equipment or install fiber optic equipment. //

B. Backbone Distribution Cables:

- 1. Meet TIA transmission performance requirements of Voice Grade Category 6.
- 2. Provide cable listed for environments where it is installed.
- 3. Technical Characteristics:
  - a. Length: As required, in minimum 1 kilometer (3,000 ft.) reels.
  - b. Size:
    - 1) Minimum 0.326 mm<sup>2</sup> (22 AWG) outside plant installation.
    - 2) Minimum 0.205 mm<sup>2</sup> (24 AWG) interior installations.
  - c. Color Coding: American Telephone and Telegraph Company Standard; Bell System Practices Outside Plant Construction and Maintenance Section G50.607.3, Issue 2 February, 1959.
  - d. Minimum Bend Radius: 10X cable outside diameter.
  - e. Impedance: 120 Ohms + 15 percent.
  - f. DC Resistance: Maximum 8.00 ohms/100 m
  - g. Shield Coverage: As required by drawing notes single shield tape design, dual shield tape design, flat shield bonded to cable jacket.
  - h. Maximum attenuation for 100m at 20° C:

FREQUENCY (MHZ)	CATEGORY 6 (DB)
.772	-
1	2.0
4	3.8

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8	5.3
10	6.0
16	7.6
20	8.5
25	9.5
31.25	10.7
62.5	15.4
100	19.8
200	29.0
250	32.8
300	
400	
500	

4. Data Multi-Conductor:

- a. Unshielded // F/UTP // cable with solid conductors.
- b. Able to handle the power and voltage used over the distance required.
- c. Meets TIA transmission performance requirements of Category 6.
- d. Technical Characteristics:
  - 1) mm2 (24 AWG) - 0.326 mm2 (22 AWG) cable
  - 2) Working Shield: 350 V.
  - 3) Bend Radius: 10 times cable outside diameter.
  - 4) Impedance: 100 Ohms + 15%, BAL.
  - 5) Bandwidth: // 250 MHz // 500 MHz //
  - 6) DC Resistance: Maximum 9.38 Ohms/100m (328 ft.) at 20 degrees C.
  - 7) Maximum Mutual Capacitance: 5.6 nF per 100 m (328 ft.).
  - 8) Shield Coverage:
    - (a) Overall Outside (if OEM specified): 100 percent.
    - (b) Individual Pairs (if OEM specified): 100 percent.
  - 9) Maximum attenuation for 100m (328 ft.) at 20° C:

Frequency (MHz)	Category 6 (dB)
1	2.0
4	3.8
8	5.3
10	6.0
16	7.6
20	8.5
25	9.5
31.25	10.7
62.5	15.4
100	19.8
200	29.0
250	32.8
300	
400	
500	

5. Fiber Optic:

- a. Multimode Fiber:

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- 1) Provide OM4 // OM2 // Type general purpose multimode fiber optic cable installed in conduit for system locations with load-bearing support braid surrounding inner tube for strength during cable installation.
  - 2) Technical Characteristics:
    - (a) Bend Radius: Minimum 152 mm (6 inches); outer jacket as required.
    - (b) Fiber Diameter: 50 // 62.5 for Bell System Interconnection Standard requirements // microns.
    - (c) Cladding: 125 microns.
    - (d) Attenuation:
      - (1) 850 nanometer: Maximum 4.0 dB per kilometer.
      - (2) 1,300 nanometer: Maximum 2.0 dB per kilometer.
    - (e) Bandwidth:
      - (1) 850 nanometer: Minimum 160 MHz.
      - (2) 1,300 nanometer: Minimum 500 MHz.
    - (f) Connectors: Stainless steel.
  - b. Single mode Fiber:
    - 1) Provide OS1 Type general purpose single mode fiber optic cable installed in conduit for all system locations with load-bearing support braid surrounding inner tube for strength during cable installation.
    - 2) Technical Characteristics:
      - (a) Bend Radius: Minimum 100 mm (4 inches).
      - (b) Outer Jacket: PVC.
      - (c) Fiber Diameter: 8.7 microns.
      - (d) Cladding: 125 microns.
      - (e) Attenuation at 850 nanometer: 1.0 dBm per kilometer.
      - (f) Connectors: Ceramic.
- C. Outlet Connection Cables:
1. Voice (Telephone):
    - a. Provide a connection cable for each TCO voice (telephone) jack in system with 10 percent spares able to connect voice (telephone) connection cable from voice (telephone) instrument to TCO voice (telephone) jack. Do not provide voice (telephone) instruments or equipment.
    - b. Technical Characteristics:
      - 1) Length: Minimum 1.8 m (6 feet).
      - 2) Cable: Voice Grade.
      - 3) Connector: RJ-11/45 compatible male on each end.
      - 4) Size: Minimum 24 AWG.
      - 5) Color Coding: Required, telephone industry standard.
  2. Data:
    - a. Provide a connection cable for each TCO data jack in system with 10 percent spares to connect a data instrument to TCO data jack. Do not provide data terminals/equipment.
    - b. Technical Characteristics:
      - 1) Length: Minimum 1.8 m (6 feet).
      - 2) Cable: Data grade Category 5E or on a case-by-case basis Category 6 for specialized powered systems accepted by SMCS 005OP2H3 (202) 461-5310, IT and FMS Services and COR.
      - 3) Connector: RJ-45 male on each end.
      - 4) Color Coding: Required, data industry standard.
      - 5) Size: Minimum 24 AWG.
  3. Fiber Optic:

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- a. Provide a connection cable for each TCO fiber optic connector in system with 10 percent spares. Provide data connection cable to connect a fiber optic instrument to TCO fiber optic jack. Do not provide fiber optic instruments/equipment.
  - b. Technical Characteristics:
    - 1) Length: Minimum 1.8 m (6 feet).
    - 2) Cable: Flexible single conductor with jacket.
    - 3) Connector: LC // SC // male on each end.
    - 4) Size: To fit // OM1 single mode or // OM4 multimode cable.
- D. System Connectors:
1. Modular (RJ-45/11 and RJ-45): Provide voice and high speed data transmission applications type modular plugs compatible with voice (telephone) instruments, computer terminals, and other type devices requiring linking through modular telecommunications outlet to the system compatible with UTP // F/UTP //cables.
    - a. Technical Characteristics:
      - 1) Number of Pins:
        - (a) RJ-45: Eight.
        - (b) RJ-11/45: Compatible with RJ-45.
      - 2) Dielectric: Surge.
      - 3) Voltage: Minimum 1,000V RMS, 60 Hz at one minute.
      - 4) Current: 2.2A RMS at 30 minutes or 7.0A RMS at 5.0 seconds.
      - 5) Leakage: Maximum 100  $\mu$ A.
      - 6) Connections:
        - (a) Initial contact resistance: Maximum 20 milli-Ohms.
        - (b) Insulation displacement: Maximum 10 milli-Ohms.
        - (c) Interface: Must interface with modular jacks from a variety of OEMs. RJ-11/45 plugs provide connection when used in RJ-45 jacks.
        - (d) Durability: Minimum 200 insertions/withdrawals.
- E. Fiber Optic Terminators:
1. Pre-polished crimp on type that has proper ferrule to terminate fiber optic cable.
  2. Technical Characteristics:
    - a. Frequency: Light wave.
    - b. Power Blocking: As required.
    - c. Return Loss: 25 dB.
    - d. Connectors: LC // SC // .
    - e. Construction: Ceramic.
- F. Conduit and Signal Ducts:
1. Conduit:
    - a. Provide conduit or sleeves for cables penetrating walls, ceilings, floors, interstitial space, fire barriers, etc.
    - b. Minimum Conduit Size: 19 mm (3/4 inch).
    - c. Provide separate conduit and signal ducts for each cable type installation.
    - d. When metal (plastic covered, flexible cable protective armor, etc.) systems are authorized to be provided for use in system, follow installation guidelines and standard specified in Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS and NEC.
    - e. Maximum 40 percent conduit fill for cable installation.
  2. Signal Duct, Cable Duct, or Cable Tray: Use existing signal duct, cable duct, and cable tray, when identified and accepted by COR.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install for ease of operation, maintenance, and testing.
- B. Install system to comply with NFPA 70 National Electrical Code, NFPA 99 Health Care Facilities, NFPA 101 Life Safety Code, Joint Commission Manual for Health Care Facilities, and original equipment manufacturers' (OEM) installation instructions.
- C. Cable Systems Installation:
  - 1. Install system cables in cable duct, cable tray, cable runway, conduit or when specifically approved, flexible NEC Article 800 communications raceway. Confirm drawings show sufficient quantity and size of cable pathways. If flexible communications raceway is used, install in same manner as conduit.
  - 2. Coordinate outside plant and backbone cables to furnish number of cable pairs for system requirements and obtain approval of COR and IT Service prior to installation.
  - 3. Bond to ground metallic cable sheaths, etc. (i.e. risers, underground, horizontal, etc.).
  - 4. Install temporary cable to not present a pedestrian safety hazard and be responsible for all work associated with removal. Temporary cable installations are not required to meet Industry Standards, but must be reviewed and accepted by COR, IT Service, FMS and SMCS 005OP2H3 (202-461-5310) prior to installation.
- D. Patient Bedside Prefabricated Units (PBPU) Installation:
  - 1. Under no circumstances, proceed with installing PBPU without written approval of PBPU OEM and specific instructions regarding attachment to or modifying of PBPU.
  - 2. Maintain UL integrity of each PBPU. If installation violates UL integrity, obtain on site UL re-certification of violated PBPU at the direction of COR.
- E. Labeling:
  - 1. Industry Standard: Provide labeling in accordance with ANSI/TIA-606-B.
  - 2. Print lettering of labels with // laser printers // thermal ink transfer process // \_\_\_\_\_ //; handwritten labels are not acceptable.
  - 3. Label both ends of all cables in accordance with industry standard. Provide permanent Labels in contrasting colors and identify according to system "Record Wiring Diagrams".
  - 4. Termination Hardware: Label workstation outlets and patch panel connections using color coded labels with identifiers in accordance with industry standard and record on "Record Wiring Diagrams".

### **3.02 FIELD QUALITY CONTROL**

- A. Interim Inspection:
  - 1. Verify that equipment provided adheres to installation requirements of this section. Interim inspection must be conducted by a factory-certified representative and witnessed by COR.
  - 2. Check each item of installed equipment to ensure appropriate NRTL label.
  - 3. Verify cabling terminations in telecommunications rooms and at workstations adhere to color code for // T568B // T568A // pin assignments and cabling connections comply with TIA standards.
  - 4. Visually confirm marking of cables, faceplates, patch panel connectors and patch cords.
  - 5. Perform fiber optical field inspection tests via attenuation measurements on factory reels and provide results along with manufacturer certification for factory reel tests. Remove failed cable reels from project site upon attenuation test failure.
  - 6. Notify COR of the estimated date the contractor expects to be ready for interim inspection, at least 20 working days before requested inspection date, so interim inspection does not affect systems' completion date.
  - 7. Provide results of interim inspection to COR. If major or multiple deficiencies are discovered, COR can require a second interim inspection before permitting contractor to continue with system installation.

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8. Do not proceed with installation until COR determines if an additional inspection is required. In either case, re-inspection of deficiencies noted during interim inspections must be part of the proof of performance test.
- B. Pretesting:
1. Pretest entire system upon completion of system installation.
  2. Verify during system pretest, utilizing the accepted equipment, that system is fully operational and meets system performance requirements of this section.
  3. Provide COR four copies of recorded system pretest measurements and the written certification that system is ready for formal acceptance test.
- C. Microduct Tests:
1. Furnish COR, obstruction and pressure test data for each microduct installed. Complete pressure and obstruction tests per manufacturer's recommended procedures prior to installing fiber and ensure 100 percent of all microducts are compliant with manufacturer.
  2. Complete microduct pressure testing before proceeding with end-to-end microduct obstruction testing.
  3. Notify COR at least one week in advance of test date so that Government and design professional may be present to witness testing.
  4. Maintain close contact with chosen and technically-approved OEM and SMCS 005OP2H3 throughout installation, testing and certification process.
- D. Acceptance Test:
1. After system has been pretested and the contractor has submitted pretest results and certification to COR, then schedule an acceptance test date and give COR 30 days' written notice prior to date acceptance test is expected to begin.
  2. Test only in presence of a COR.
  3. Test utilizing approved test equipment to certify proof of performance.
  4. Verify that total system meets the requirements of this section.
  5. Include expected duration of test time, with notification of the acceptance test.
- E. Verification Tests:
1. Test // UTP // STP // copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield, if cable has an overall shield. Test cables after termination and prior to cross-connection.
  2. Multi-mode Fiber Optic Cable: Perform end-to-end attenuation tests in accordance with TIA-568-B.3 and TIA-526-14A using // Method A, Optical Power Meter and Light Source // and // Method B, OTDR //. Perform verification acceptance test.
  3. Single mode Fiber Optic Cable: Perform end-to-end attenuation tests in accordance with TIA-568-B.3 and TIA-526-7 using //Method A, Optical Power Meter and Light Source // and // Method B, OTDR //. Perform verification acceptance test.
- F. Performance Testing:
1. Perform Category 5E (or on a case by case basis Category 6 for specialized powered systems accepted by SMCS 005OP2H3, (202) 461-5310, IT and FMS Services and COR) tests in accordance with TIA-568-B.1 and TIA-568-B.2. Include the following tests - wire map, length, insertion loss, return loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, propagation delay and delay skew.
  2. Fiber Optic Links: Perform end-to-end fiber optic cable link tests in accordance with TIA-568-B.3.
- G. Total System Acceptance Test: Perform verification tests for UTP // STP // copper cabling systems // and // multi-mode // and single mode // fiber optic cabling systems after complete telecommunication distribution system and workstation outlet are installed.

### 3.03 MAINTENANCE

- A. Accomplish the following minimum requirements during one year warranty period:
1. Respond and correct on-site trouble calls, during standard work week:



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- a. A routine trouble call within one working day of its report. A routine trouble is considered a trouble which causes a system outlet, station, or patch cord to be inoperable.
- b. Standard work week is considered 8:00 A.M. to 5:00 P.M., Monday through Friday exclusive of Federal holidays.
2. Respond to an emergency trouble call within six hours of its report. An emergency trouble is considered a trouble which causes a subsystem or distribution point to be inoperable at any time.
3. Respond on-site to a catastrophic trouble call within four hours of its report. A catastrophic trouble call is considered total system failure.
  - a. If a system failure cannot be corrected within four hours (exclusive of standard work time limits), provide alternate equipment, or cables within four hours after four hour trouble shooting time.
  - b. Routine or emergency trouble calls in critical emergency health care facilities (i.e., cardiac arrest, intensive care units, etc.) are also be deemed as a catastrophic trouble.
4. Provide COR written report itemizing each deficiency found and the corrective action performed during each official reported trouble call. Provide COR with sample copies of reports for review and approval at beginning of total system acceptance test.

**END OF SECTION**

**SECTION 273100**  
**VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

- A. This section specifies a complete and fully functional emergency voice communication switching and routing equipment and system (hereinafter referred to as the "system") to be installed in the North Bend VA facility, (hereinafter referred to as the "facility") that includes an emergency voice and dial processing switch, government accepted equipment cabinets, interface enclosures, radio relay racks, stand-by batteries (UPS), combiners, traps, and filters; interconnection nodes and amplifiers; voice station instruments; auxiliary systems; and passive devices such as: protectors, isolators, splitters, couplers, cable patch, punch down, and cross-connector blocks or devices, cable management items, and associated hardware.
- B. Government defines system as a Critical Service Communication System and is so listed by NFPA. Its installation and operation must adhere to appropriate National, Government, and Local Life Safety and Emergency Communication Support Codes, whichever are more stringent for this facility.

**1.02 RELATED WORK**

- A. Wiring devices: Section 26 27 26, WIRING DEVICES.
- B. Lightning protection system: Section 26 41 00, FACILITY LIGHTNING PROTECTION.
- C. General electrical requirements that are common to more than one section in Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- D. Conduits for cables and wiring: Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- E. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- F. Low voltage cabling system infrastructure: Section 27 10 00, CONTROL, COMMUNICATION AND SIGNAL WIRING.
- G. Voice and data cable distribution system and associated equipment: Section 27 15 00, COMMUNICATIONS STRUCTURED CABLING.
- H. Extension of a voice communication switching and routing system: Section 27 31 31, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT EXTENSION.
- I. Emergency Service Public Address System (PAS) and associated equipment: Section 27 51 16, PUBLIC ADDRESS AND MASS NOTIFICATION SYSTEMS.

**1.03 SUBMITTALS**

- A. In addition to requirements of Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS submit the following:
  - 1. Bill of Materials.
  - 2. System cabinet and each interface cabinet layout drawing, as each is expected to be installed.
  - 3. Equipment technical literature detailing electrical and technical characteristics of each item of equipment to be furnished.
  - 4. Engineering drawings of system, showing calculated signal levels at system output, each input and output distribution point, proposed telephone outlet values, and signal level at each telephone outlet multi-pin jack.
  - 5. List of test equipment.
- B. Environmental Requirements: Confirm environmental specifications for physical TR areas occupied by system. Identify requirements for initial and expanded system configurations for:

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1. Floor loading for batteries and cabinets.
  2. Minimum floor space and ceiling heights.
  3. Minimum size of doors for equipment passage.
  4. Power Requirements: Provide specific voltage, amperage, phases, and quantities of circuits required.
  5. Air Conditioning, Heating, and Humidity Requirements:
    - a. Identify ambient temperature and relative humidity operating ranges required to prevent equipment damage.
    - b. Air conditioning requirements expressed in BTU per hour, based on adequate dissipation of generated heat to maintain required room and equipment standards.
  6. Proposed floor plan, based on expanded system configuration of proposed system for this facility.
  7. Conduit size requirement (between main TR, remote TR, Telephone Equipment Room, MCR and devices).
- C. Submit samples of reports generated by TMS with technical submittal for evaluation of formats and compliance with information field content.
- D. Needs Analysis Report: Provide summary report of the needs analysis conducted per requirements of this section.
- E. Provide current and qualified OEM training certificates and OEM certification for contractor installation, maintenance, and supervisory personnel.
- F. Proof of Performance Test Plan: Provide COR and SMCS 005OP2H3 (202) 461-5310 with a Proof of Performance Test Plan 90 days prior to cut-over of system.
1. Include tests to demonstrate system's capabilities of providing indicated services.
  2. Use only test equipment accepted by SMCS 005OP2H3 (202) 461-5310 and COR included with acceptance test plan.
  3. Submit test equipment certification verifying calibration within six months of system cut-over.
- G. Closeout Submittals:
1. Provide two copies of OEM developed training video presentation for evaluation and approval by COR.
  2. Provide spreadsheet with details of the complete record program in memory for associated station assignments.
  3. Provide a written commitment from system equipment OEM to supply parts and on-site engineering support services for one year warranty service (materials and labor).
  4. Provide OEM certification allowing, OEM or authorized distributor to fully support contract (initial installation, warranty service for warranty period of the contract).
    - a. System equipment OEM's signatory of certified written commitment must be of an individual who has full authority to obligate OEM to this commitment.
    - b. Include names, corporate addresses, and telephone numbers of individuals who have this authority as a part of the commitment.
- H. Maintenance Material Submittals:
1. Furnish 5 percent spare protectors for lightning protection system.
  2. Furnish one spare audio monitor panel.
  3. Furnish on spare electrical supervision panel.
  4. Furnish a complete set of system electronic modules and cards to be used as on-hand operational emergency spare equipment. One each of T-1, DS-\*\*, interface cards etc. is the minimum required or a compliment as directed by OEM. Confer with SMCS 005OP2H3 to determine other spare items required to equip system with emergency repair capabilities that completely adhere to system warranty requirements.

**1.04 QUALITY ASSURANCE**

- A. Supervision:
1. Provide a full time on-site project manager, effective on issuance of notice to proceed, responsible to coordinate and supervise contractor and sub-contractor personnel in all phases of installation, training, inspection, cutover, and final acceptance of system. Deliver project manager a complete copy of these specifications to include all amendments prior to start of installation.
  2. Coordinate and conduct system data base survey with SMCS 005OP2H3, (202) 461-5310, COR and a member of IT Service identifying all programming of features, classes of service, and equipment installed by type and physical location as specified in this document and all attachments thereto. After survey is completed, turn over a complete list of equipment to COR for approval by SMCS 005OP2H3, (202) 461-5310, prior to start of installation.
  3. Ensure that project manager and skilled personnel remain on premise until items on the punch list, developed during inspection, cut-over, and acceptance testing of system are completed, inspected, and accepted by COR.
  4. Be responsible for any and all coordination with LEC relative to interface with commercial telephone system; be responsible for removal of voice and data equipment and cabling abandoned by LEC, Government, or other organizations and not retained for exclusive use by Government as a result of this installation.
- B. Needs Analysis (required for replacement of existing systems): Conduct a needs analysis of existing facility with representatives from IRM and various departments to determine system's requirements. Depict system features and capacities, in addition to specific site requirements.
1. System:

ITEM WIRED	EQUIPPED CAPACITY	WIRED CAPACITY
Main Station Lines:		
Single Line		
Multi Line (Equipped for direct inward dialing)		
Central Office Trunks:		
Two Way		
DID		
Two-way Dial Repeating Tie Line		
Foreign Exchange (FX)		
Conference		
Audio Paging Access		
Off-Premise Extensions		
CO Trunk By-Pass		
Monitors w/keyboard(s)		
Printer(s)		
Operator Console(s)		
T-1 Access/Equipment		
Maintenance Terminal		

2. Projected Maximum Growth: Identify projected maximum growth for each item identified in this section. For this purpose, the following definitions are provided to detail system's capability:

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- a. Provide software and hardware required to equip system with items listed under equipped capacity, 30 days prior to system cut-over.
  - b. Wired Capacity to include wiring and equipment listed under wired capacity, with the exception of line, data, and trunk cards, provided and tested 30 days prior to system cutover.
  - c. Expand system to projected maximum growth through use of printed circuit boards and modular cabinets that do not require extensive re-wiring and reprogramming.
3. Cable Distribution System: Refer to Section 27 15 00, COMMUNICATIONS STRUCTURED CABLING, for specific cable distribution system requirements. Contractor is required to formulate a projected cable and TCO count that coincides with projected maximum growth described herein.
  4. Telephone Instruments (Stations): Telephone instruments are an integral component of system. Indicate each instrument location, type of instrument and class of service as determined by the needs analysis // or as shown on drawings //.

#### 1.05 WARRANTY

- A. Work subject to terms of Article "Warranty of Construction," FAR clause 52.246-21.

### PART 2 PRODUCTS

#### 2.01 PERFORMANCE AND DESIGN CRITERIA

- A. Conform to CFM OI&T Design Guide.
- B. Conform to CFM Electrical Design Manual (EDM-PG18-10, current edition).
- C. Perform the following minimum services designed in accordance with and supported by OEM:
  1. Provide continuous inter- and intra-facility voice service.
  2. Capacity size and install systems so that loss of connectivity to an external telephone systems, VoIP and facility's LAN/WAN systems does not affect facility's operation in specific designated emergency operating locations and instruments - including the Commission and NFPA 101 listed Analog Emergency By-Pass Phones; Police Emergency Call Equipment (Parking Lots, Stairwells, Duress Alarms and Locator); Code Blue (One, FAX, Patient Phones).
  3. Inter-operate, connect, and function fully with existing Local (Telephone) Exchange Company (LEC) Networks, Federal Telephone Service (FTS) Inter-city Networks, Inter-exchange Carriers, Integrated Services Digital Network (ISDN) and Voice over Internet Protocol (VoIP) at a minimum (NOTE: VoIP Service is not allowed to perform Facility Safety of Life Functions as well as facility's LAN/WAN. Contact SMCS 005OP2H3, (202) 461-5310 for specific technical assistance and approvals.
  4. Contain control and switching equipment, voice and digital system, with attendant consoles.
  5. Contain voice mail and automatic attendant functions and continuous intra- and inter-facility voice service.
  6. Provide universal night answering function from facility designated remote locations.
  7. Direct access to trunk level equipment including audio paging, Industry Standard "T" and "DS" carrier protocols, and external protocol converters.
  8. Provide connections to "T" and "DS" access/equipment or Customer Service Units (CSU or DTE) used in Federal telephone service and other trunk applications. Provide T-1 equipment required to terminate and make operational the quantity of circuits designated. Connect CSUs to system's emergency battery power supply. Provide system capable of operating in industry standard DS protocol and provide that level of service when required.
  9. Contain attendant and operator consoles, video monitors with keyboards, and printers to provide employee directory access from Traffic Management System (TMS). Provide identical capabilities at console positions, video monitors, and keyboards. Provide attendant consoles accepting a mixture of trunk types and extend calls received via these trunks to station users.

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10. Be capable of interfacing and operating with Direct-Incoming-Dial (DID) service to stations as identified herein without affecting intra-facility operation. Provide DID trunk group that must operate as a separate trunk group from other Central Office (CO) trunks.
  11. Contain the designated number of telephone instruments, where each instrument (also referred to as "station") has ability to direct dial other facility telephone stations, public telephone network, tie-lines, and FTS telephone numbers without attendant assistance. Provide dual tone multi-frequency (DTMF) for intra-facility and external-facility calling at each station. The term DTMF, as used herein, is defined as "a dialing or analog operation".
  12. Provide standard digital // VoIP // telephone instruments at designated TCOs.
  13. Provide at designated TCOs and locations shown on drawings, "Special Hands Free" digital // VoIP // telephone instruments.
  14. Receive specified telephone signals acquired from LEC and FTS contracted carrier, process and distribute them to designated telephone stations, as determined by Class of Service (CoS).
  15. At a minimum, provide four // or \_\_\_\_\_ // TCOs on each TER //, MCR//, and TR// wall and on either side of each door opening.
  16. Interface and connect telephone multi-pin jack to system via 110 type punch blocks in TER //, MCR//, and TR// meeting Category 5E level of service.
  17. Perform adjacent channel operation a minimum of local, long distance, and Federal telephone service telephone signals. Install and interface system equipment according to OEM's schematic diagram for adjacent telephone channel operation. Provide testing capability in each equipment cabinet, rack, interface point and test ports that provide access for each telephone channel without need to disconnect distribution cables or equipment. Process each telephone channel as a single channel. Include a means of monitoring complete system with appropriate printout and archiving of each processed and distributed channel.
  18. Design system to minimize cross talk, background processor noise, inter-modulation, and other signal interference. Install and interface system equipment according to OEM head-end schematic diagram for adjacent audio channel operation. Process each audio input channel as a single separate channel and combine into one output channel. Provide, in the telephone switch room, an audio and visual monitoring panel to test each converted audio input and distribution channel and analog channels, transmitted and received signal functions. Electrically supervise system's Alternating Current (AC) power input, stand by batteries and charger, internal Direct Current (DC) power supply primary voltages and currents; and each remote control unit, audio //, and analog RF// interface unit, from TER. Provide in TER, telephone operator room, MCR, Police Security Service Control Console //, MAS Emergency Room, //, and \_\_\_\_\_ // to check supervisory signals, signal level, audio sound and visual level, and alert personnel to problems.
  19. //Provide Digital Signal Processor Resources for a non-blocking telephone system.//
  20. Point Of Local (Telephone) Exchange Company Demarc: Notify COR if signals at LEC interface point do not meet minimum signal level and quality, detailing the nature of the deficiencies, and expected effect on the telephone signals in the new system.
  21. System must acquire telephone signals at // \_\_\_\_\_ //.
  22. A minimum of // \_\_\_\_\_ // analog emergency telephone connections must be acquired at // \_\_\_\_\_ // and connected to // \_\_\_\_\_ // analog back up circuits.
  23. System Location Selection: Locate system cabinets and associated equipment in the building // \_\_\_\_\_ // floor.
- D. System Performance:
1. Support and fully operate in the following functional modes:
    - a. ISDN Integrated Services for Digital Networks:
      - 1) Basic Rate Interface (BRI).

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- 2) Primary Rate Interface (PRI).
    - b. Fiber-optic Distributed Data Interface (FDDI).
  2. System Sensitivity: Provided satisfactory service for at least 3,000 feet for all voice locations.
  3. Minimum System Operating Parameters:
    - a. System Speed: Minimum 1.0 giga-Bits (gb) per second.
    - b. Impedance: 600 Ohms, BAL.
    - c. Cross Modulation: -60 decibel (dB).
    - d. Hum Modulation: -55 dB.
    - e. System Data Error: Minimum 10 to the -10 Bits per second (Bps).
    - f. Loss: Measured at frame output with reference Zero (0) decibel measured (dBm) at 1,000 Hertz (Hz) applied to frame input:
      - 1) Trunk to station: Maximum 1.5 dB.
      - 2) Station to station: Maximum 3.0 dB.
      - 3) Internal switch crosstalk: -60 dB when a signal of + 10 dBm, 500-2,500 Hz range is applied to primary path.
    - g. Idle channel noise: 25 dB relative noise per channel (rnC) or 3.0 dBm at 0 above (terminated) ground noise, whichever is greater.
    - h. Traffic Grade of Service for Voice: Minimum grade P-01 with an average traffic load of 7.0 One Hundred Call Seconds (CCS) per station per hour.
    - i. Average CCS per Voice Station: CCS capacity maintained at 7.0 CCS and a Time Between Failures (TBF) of 99.99 percent when system is expanded up to the projected maximum growth.
- E. Voice and Audio Standards:
  1. Input and Output Signal Level: 0.0 dBm at 1 kilo Hertz (kHz) test tone modulation level.
  2. Input and Output Impedance: 600 Ohms Balanced (BAL).
  3. Input and Output Signals: Terminated on each system unit.
  4. Frequency Range: Minimum 50 Hertz (Hz) to 3.0 kHz + 1.0 percent.
  5. Signal-to-Noise Ratio: 60 decibel per milli-Volt (dBmV) + 1.0 dBmV.
  6. Cross Modulation: -46 dB.
  7. Hum Modulation: -55 dB.
  8. Isolation (control unit to unit): Minimum 24 dB.
- F. Control Signal Standards:
  1. Input and Output Signal: 0.0 dBmV + 1.0 dBmV Level.
  2. Input and Output Signals Terminated on each system unit.
  3. Input and Output Impedance: 600 Ohms, BAL.
  4. Channel Bandwidth - Voice: Minimum 50 Hz to 3.0 kHz, + 5.0 percent.
  5. S/N Ratio: 60 dBmV + 1.0 dBmV.
- G. Telephone Outlet (TCO):
  1. Isolation (outlet-outlet): Minimum 24 dB.
  2. Impedance: 600 Ohms.
  3. Signal Level: 0 dBmV + 0.1 dBmV.
  4. System Speed: Minimum 100 mega-Bits (mb) per second.
  5. System Data Error: Minimum 10 to the -6 Bits per second.
- H. Auxiliary Systems:
  1. // Provide Public Address System (PA) interface as described in Section 27 51 16, PUBLIC ADDRESS AND MASS NOTIFICATION SYSTEMS. //
  2. // Provide direct access to selected zones and all zones paging from each telephone console. //
  3. // Provide console attendant "priority access" (or ALL CALL or CODE ONE or BLUE) to all zones. Selected station users have access to appropriate zones via sub zones, by dialing

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- the proper access. //
4. // Provide required NFPA and UL certified devices for PA to be interfaced to a designated critical care emergency communications telephone system. //
  5. // Provide feature to prevent PA from being "locked up" by a user placing system on hold or leaving receiver off-hook. //
- I. General Product Requirements:
1. Provide current model of standard products of OEM of record. OEM of record to be defined as a commercial business enterprise manufacturing items of equipment and which:
    - a. Maintains a factory production line for equipment submitted.
    - b. Maintains a stock of replacement parts for equipment submitted.
    - c. Maintains engineering drawings, specifications, and operating manuals for equipment submitted.
    - d. Has published and distributed descriptive literature and equipment specifications on equipment submitted at least 30 days prior to the Invitation for Bid.
  2. Specifications of equipment as set forth in this document are minimum requirements, unless otherwise stated.
  3. Where standards are established for supplies, materials or equipment, furnish supplies, materials and equipment listed by NRTL.
  4. Provide equipment labeled with approved seal of NRTL.
  5. Provide COR with verification, at time of installation type of cable being provided is recommended and approved by OEM. Provide cabling meeting requirements of NRTL, TIA Wiring Standards and requirements of NFPA 70. Coordinate correct protection, cable duct and conduit with subcontractors.
  6. Interface with telephone //, PA// and, \_\_\_\_\_// systems utilizing interfacing methods approved by OEM and Government. Acceptable interfacing method requires not only a physical and mechanical connection, but includes matching of signal, voltage, and processing levels, with regard to signal quality and impedance. Provide separation of Critical Care, Life Safety, and Emergency systems.
  7. Connect //PA// interface cabling from system via its system telephone interface unit using telephone equipment and //PA interface equipment// as interface point. Furnish telephone interface unit //and PA interface unit; do not install connections to PA system. //
  8. Provide solid state active electronic component rated for continuous duty service and complying with FCC standards, for telephone equipment, systems, and service.
  9. Provide passive distribution equipment with -80 dB radiation shielding specifications or greater.
    - a. Terminate interconnecting twisted pair cables on equipment terminal boards, punch blocks, breakout boxes, splice blocks. Terminate unused equipment ports/taps according to OEM's instructions for telephone cable systems without adapters. Terminate unused or spare twisted pair cable, and fiber-optic cable that is unconnected, loose or unsecured.
    - b. Utilize microprocessor components for signaling, programming circuits and functions. Ensure program memory is non-volatile or protected from erasure during power outages for a minimum of three days.
    - c. Provide continuous electrical supervision of system equipment, interconnecting cabling, distribution cable plant, and UPS back up battery and charger to determine change in status and to assist in trouble shooting system faults.
    - d. Voltage: Not to exceed 30V AC Root Mean Squared (RMS) or 42V direct current (DC), except for primary power to power supply circuits.
    - e. Color Coded Distribution Wiring: Conform to ANSI/TIA-606-B standard. Clearly and permanently label equipment, cable duct and conduit, enclosures, wiring, terminals, and cables according ANSI/TIA 606-B standard record wiring diagrams, to facilitate installation and maintenance.



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- f. Connect primary input power to critical branch of emergency AC power distribution system.
- g. Provide UPS sized for equipment to function and operate normally during input power fluctuations or loss of power for a minimum of four hours.
- h. Provide plug-in connectors to connect equipment.
- i. Utilize barrier terminal screw type connectors, at a minimum for base band cable systems.
- j. Crimp Type Connectors:
- k. Type installed with a ratchet tool are an acceptable alternative if cable dress, pairs, shielding, grounding, connections and labeling are provided same as barrier terminal strip connectors.
- l. Tape of any type, wire nuts, or solder type connections will not be permitted.
- m. Provide stainless steel, anodized aluminum faceplates, or UL approved cyclac plastic matching equipment.
- n. Provide noise filters and surge protectors for each equipment (including interface cabinets) control console, local, and remote active equipment locations to ensure protection from input primary AC power surges and noise glitches.

**2.02 EQUIPMENT**

A. Equipment Functional Characteristics:

FUNCTIONS	CHARACTERISTICS
Input Voltage	105 to 130 VAC
Power Line Frequency	60 Hz $\pm$ 2.0 Hz
Operating Temperature	0 to 50 degrees centigrade (C)
Humidity	80 percent minimum rating

B. System Equipment:

1. Self-contained, electronic, digital // and VoIP // in operation, providing the following minimum functions:
  - a. Intra-facility station-to-station four digit direct dialing to include those telephone instruments equipped with DID features.
  - b. Direct-output-dial (DOD) from any unrestricted telephone instrument to any CO trunk, ISDN, or FTS access lines by dialing a pre-designated access code.
  - c. DOD from any station to tie lines by dialing a pre-designated access code.
  - d. Ability of incoming calls from FTS access lines and tie lines to direct dial system stations without attendant assistance.
  - e. Access to outside lines through operator's console at restricted telephone instruments.
  - f. Access to features, functions, CO trunks, FTS access lines, tie-lines, toll free numbers, and long distance directory assistance from unrestricted telephone instruments.
  - g. Minimum 40 Class-of-Service (COS) restrictions to be applied individually or in combination as dictated by individual telephone number service requirements. Describe number and type of COS restrictions available in submittals.
2. Provide station users with standard feature package listed by this paragraph, and provide ability to restrict any of these features on a station by station basis.
  - a. Line Hunt Capability: Assign sequential and circular line hunting lines to a hunt group submit number of hunt groups available and capacity of each group.
  - b. Consultation Hold: Capability to place an incoming call on hold while making a consulting call, then return to original call.
  - c. Call Transfer: Permit a user to transfer an incoming or outgoing CO trunk, FTS, or tie-line call to another system station without attendant assistance.

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- d. Call Pick-Up: Answer a ringing, but unanswered call, within a pre-designated group of station lines by dialing a feature code or activating a feature button.
- e. Call Forwarding "Follow Me" Functions: Automatically reroute incoming calls to another selected telephone number. Activate and deactivating this feature from selected telephone instruments at their discretion.
- f. "Busy and Don't Answer" Functions: Automatically reroute calls to a pre-programmed secondary telephone instrument when a given telephone instrument is busy or does not answer within a prescribed time interval.
- g. Call Queuing: Telephone instrument encountering a busy trunk, e.g. CO, FTS, Foreign Exchange Service (FX), and tie-lines, can be automatically connected to the trunk when it becomes available.
- h. Call Back/Ring Back: Call back/ring back is activated at calling instrument initiating call to another internal busy instrument by an access code or feature button. Automatically ring calling instrument when both instruments become idle, and when answered, rings called instrument without preventing calling instrument from originating or receiving other calls.
- i. Music on Hold: Provide music on hold to system station lines, CO trunks, FTS access lines, and tie-lines when placed on hold. Acceptable music source is digital media player as accepted by SMCS 005OP2H3 and COR. Off air radio or non-royalty sources cannot be used for this function.
- j. Conferencing: A telephone instrument initiated conference (minimum of three parties) which allows stations to conference any combination of telephone instrument, CO, or FTS calls.
- k. Automatic Number Identification: A facility where directory number or equipment number of a calling instrument is obtained automatically for use in message accounting.
- l. Station to Station Call Waiting: Busy telephone instruments allowed to receive a second incoming call from another telephone instrument. Play call waiting tone on busy instrument, upon receiving a second incoming call. The busy instrument has ability to place initial call on hold and answer second call and alternate between both calls.
- m. Station and System Speed Dialing:
  - 1) System Speed Dialing: Minimum 50 numbers allow designated telephone instruments to originate speed calls to CO, FTS, FX, or tie lines.
  - 2) Station Speed Dialing: Ten numbers per instrument; instrument includes capability of entering, removing, or changing numbers programmed on their Station Speed dialing list.
- n. Call Park: Telephone instrument feature must be provided that allows non-preselected internal instruments to access an attendant initiated feature in response to an internal/external paging situation.
- o. Universal Night Answer Service: Provide a means of night service transfer for answering incoming calls, which would normally be answered at console, from locations other than console. Chimes, with cut-off switches, to announce incoming calls placed at two locations.
- p. Line Load Control: A pre-programmed attendant controlled feature which, when activated from console positions, restricts all but selected stations from accessing FTS and CO trunks during emergency conditions. Activation of line load control must not affect intra-facility communications, e.g., station to station, access to Public Address system, audio-page, etc.
- q. Dual Common Controls: The following are the minimum features required:
  - 1) Provide a redundant common processing unit with automatic transfer capability offering a stored program technology control feature.
  - 2) Either common control is capable of handling the total system traffic load without degradation of service.

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- 3) In event of failure of primary common control automatically switch to redundant unit with no interruption to calls in progress and no loss of program features.
- r. Line Lock Out:
- 1) In event a telephone instrument handset is not replaced in telephone instrument cradle, after a pre-determined time interval with no dial action lock out that station line, i.e., not tie up system switch equipment.
  - 2) Apply audible tone to locked out station lines.
  - 3) Automatically restore associated station line to full service when a locked-out telephone instrument handset is replaced.
- s. Supervisory Telephone (not Electrical or Electronic) Signaling and Ringing:
- 1) Provide dual solid state signal generating devices, or equivalent, which produce standard supervisory signaling, i.e., ringing, dial tone, busy tone, etc. A maximum one-third of installed main station line capacity can be affected by failure of any one signal generating device.
  - 2) Provide automatic transfer to alternate signal generating device in event of failure of primary device for dual solid state signal generating devices.
  - 3) Supervisory Signaling and Ringing:
    - (a) Provide tones to indicate progress of a call through the exchange, i.e. dial tone - to indicate that switching equipment is ready to receive dial digits and, when required, provide a secondary dial tone for FTS 2000 access; busy tone (60 to 120 interruptions per minute) - to indicate that a busy line or trunk has been encountered; audible ring back tone - to indicate to calling subscriber that the number dialed is being called.
    - (b) Provide supervisory signaling and ringing devices capable of operating from emergency DC power source.
- t. Fusing:
- 1) Equip system with fuses to protect total telephone system and individual segments of system so that a problem in one segment can be isolated without damaging the total system.
  - 2) Provide alarm indicating type fuses with their rating designated by numerical or color code on fuse panels that are easily visible.
- u. Equipment Power Supply:
- 1) Equip system with a complete on-line power supply consisting of AC surge protection, dual load-sharing rectifiers/chargers, batteries, and inverter.
  - 2) Capacity of power supply must support system including projected maximum growth and as required in this specification for interfaced equipment.
  - 3) Coordinate with Local Exchange Company (LEC) to determine CO trunk, FTS access line, and other required interface unit power requirements and provide power to interface units so they can continue to function in event of a commercial AC power failure.
- v. UPS with Battery Back-up or Reserve Battery Power Supply:
- 1) Provide reserve battery power supply with capacity to supply system for a minimum of four hours including projected maximum growth and interfaced equipment consisting of minimum // 24 // \_\_\_\_\_ // sealed maintenance-free cells. Dry cell batteries are not acceptable. Include capability of adjustable voltage for float or equalizing batteries.
  - 2) Provide fully redundant system (not including batteries and inverter) with rectifier or charger capacity to support combined load requirements of system at its maximum growth and interfaced equipment.
- w. Alarms and Trouble Indicators: It is acceptable to combine required electrical and electronic supervision functions in these panels provided supervisory standards are met.

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- 1) Provide and make operational visual and audible alarms, equipped with cut-off switches, indicating AC power failure, rectifier failure, major and minor trouble, temperature/humidity, electrical or electronic supervisory alarms. Provide sensors for remote environmental alarms at attendant console area and one other location. Separate these alarms in addition to major and minor alarms on attendant consoles.
  - 2) Provide small red indicator lamps on alarm panel for each alarm with cut-off switches or one switch for all alarms and distinctive audible alarms. If one cutoff switch is provided for all audible alarms, restore alarms to ready status condition for audible registration of additional alarms.
  - 3) On submittal describe other system alarms that are remote and describe system alarms/indicators of malfunctions that are located on the equipment.
- x. Provide capability of system to provide four-digit intra-station dialing and desired functions described herein.
  - y. Due to varied trunk group requirements and possible future trunk group requirements, e.g. public address system access, alternate access codes can be proposed. Grouping of similar type trunk group/features, e.g. 5-1 public address system (all call), 5-2 public address system zone 1, etc. is acceptable.
  - z. Provide emergency numbers accessible by system station users. Label numbers on console or a multi-line instrument and at least one other designated location. Provide a distinctive audible and visual signal associated with emergency number to ensure an immediate response to calls. Provide capability of priority answering emergency number and extending the call as situation dictates at console or multi-line instrument. A modified trunk circuit can be used for this purpose.
    - 1) Provide sensitivity for voice service up to 914.4 m (3,000 feet).
3. Voice Mail Requirements:
- a. Requirement is an automated call processing capability. Connect automated attendant to system and configured to answer and route calls received on a predetermined number of central office trunks. Configure system so that, if called extension is busy or does not answer within a predetermined number of rings, route caller to person's voice mail box. Provide complete voice mail system allowing predetermined number of users to send complete and confidential messages in users' voice and receive complete and confidential messages in senders' own voice 24 hours per day, 7 days per week. Integrate into operation of system and be compatible with local telephone company central office.
  - b. Provide capacity for the following number of ports (minimum):
 

	Equipped Capacity	Wired Capacity
Automated Attendant	12	20
Voice Mail	12	20
  - c. Provide voice mail system for 500 mailboxes and 40 hours of storage with growth to 60 hours of storage.
4. Voice Mail Features:
- a. Access to system and its features from any instrument anywhere that provides DTMF signaling.
  - b. Ability of those leaving a message to review message and edit message that is being placed in mailbox.
  - c. Privacy/Security through use of a password.
  - d. Ability to send messages to users on voice mail system in the following manner:
    - 1) To any user on same voice mail system.
    - 2) To more than one user on same voice mail system - an ad hoc distribution list determined by sender at time of message transmission.

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- 3) To a predetermined distribution list.
  - 4) Broadcast to users on same voice mail system.
  - e. Verification, with Receipt: Ability of a user to request and receive verification of when a message is played through the use of a touch-tone command. Indicate time and date of when a message is played and place that information in sender's mailbox.
  - f. Envelope Information: Ability of a user to request and receive time and date information of when specific messages were left in user's mailbox.
  - g. Connects to voice mail system through system extension number or a seven/ten digit telephone number from LEC.
  - h. Message "PROMPTS" for every transaction: Provide Messages for "GREETINGS" and "INSTRUCTIONS FOR RECORDING OR EDITING A MESSAGE".
  - i. Notify user that messages are in user's mailbox with a message waiting tone, lamp, and display.
  - j. Notify user, upon accessing system, of how many messages are in user's mailbox.
  - k. Message Response Alternatives:
    - 1) Respond or send a reply to another user on same voice mail system.
    - 2) Route message to another user on same voice mail system.
    - 3) Delete message.
    - 4) Save message.
  - l. Ability to fast forward or rewind messages.
  - m. Present messages to user on a "FIFO" basis.
  - n. User Administration: Provide management information and statistics in the following categories:
    - o. Port Usage: Traffic statistics on each access path into system.
    - p. Usage of Storage Capacity: Remaining storage capacity at any one time and during peak periods.
    - q. Mailbox Usage: Connect time and number of new or saved messages.
  - r. User administration terminal to allow for "Class of Service Controls" in the following areas and for the following parameters:
    - 1) Initial Authorization:
      - (a) Ability to enable a mailbox.
      - (b) Record "Owner's" name.
      - (c) Set initial Pass Number.
    - 2) Usage Control:
      - (a) Length of personal greeting.
      - (b) Length of messages received.
      - (c) Number of messages.
      - (d) Message retention time.
    - 3) Feature Authorizations: Allowed or not.
      - (a) Group List Creation.
      - (b) Group List Usage.
      - (c) Broadcast Messages.
- C. Voice Traffic Management System (TMS):
- 1. Provide complete and self-contained on-site TMS.
  - 2. Functions:
    - a. Provide laser printer for reports generated by system and maintenance administration terminal.
    - b. Connect TMS to system emergency battery power supply.
    - c. Screen menus to provide access to each category of reports.
    - d. Traffic Accounting and Management Call Detail Recording (CDR) for Voice Circuits (TMS):
      - 1) Include hardware, software, and interconnections for complete system.

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- 2) Contain a database stored on non-volatile media.
  - 3) Provide line numbers, physical locations of equipment by building and room number, department to which a line is assigned, name of persons assigned to a number, type of equipment, and any comments regarding system features.
  - 4) Support additional input and output (I/O) ports for video monitors or other terminals that allows a passive display of data bases by authorized medical center personnel other than those individuals responsible for data input and conducting studies.
  - 5) Protect data bases with user ID and password.
  - 6) Provide separate voice line reports, on demand and predetermined schedule, for automatic printing. The following reports are required:
    - (a) Originating trunk traffic by trunk group, expressed in CCS.
    - (b) Terminating trunk traffic by trunk group, expressed in CCS.
    - (c) All trunks busy, by trunk group, expressed as blocked call count.
    - (d) All equipment busy, i.e., no dial tone and failure to complete cross-office call because of all equipment busy, expressed in blocked call count.
    - (e) List of equipment alarms, error tables, trouble logs, history files, etc.
  - e. Measurements for each console:
    - 1) Incoming calls.
    - 2) Calls answered.
  - f. Provide remote video monitors compatible with TMS hardware and software in immediate vicinity of telephone operators for use as an on-line directory lookup system of facility personnel.
  - g. Print reports in English notation that do not require interpretation of abbreviations or codes by the user.
  - h. Provide storage on disk to prevent a purge of stored data. Maintain call record and facility usage data in database for a minimum 30 days with storage capability of accommodating a minimum 5,000 calls per day.
  - i. Furnish normal system traffic data to appropriate facility staff within seven days of a facility request. Prepare quarterly and submit, to appropriate facility staff, a comprehensive traffic study, including the required traffic data with the contractor's comments and recommendations.
  - j. Load and maintain directory that includes, name, title, organization, location, extension, and class-of-service.
  - k. Provide cable plant management function with the following minimum requirements:
    - 1) A list of off-premise cable by circuit number, numbers of pairs for each circuit, and circuit definition.
    - 2) Complete cable plant distribution record to identify location (cable pair) on main distribution frame, riser, cable size, cable pair in-use (main cable feeder and station cable), building and room number of termination, and equipment type terminated.
    - 3) Automatically provide the cable number and pair assignments, when service order is entered.
  - l. Provide equipment inventory list containing the following minimum requirements:
    - 1) System cabinets, cards (active and spares), batteries, current and surge protectors, rectifiers, peripheral equipment, i.e. public address etc.
    - 2) Quantity of single and multi-line telephones, speakerphones, dial intercom units, speakers, gongs, loud horns, bells, chimes, recorders, etc.
    - 3) A list of equipment as being used or spare; ordered or received; installed date, warranty date, cost, location, serial number, etc.
  - m. Provide electrical and/or electronic supervisory alarms and faults reports.
- D. Attendant Console:
1. Attendant consoles must be compatible with local commercial telephone system:

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- a. Powered from system's emergency battery power supply.
  - b. Load sharing to ensure that all incoming calls are evenly distributed among consoles regardless of traffic load.
  - c. Telephone signal (not electrical or electronic) supervision over all calls connected through console providing indication of:
    - 1) Called party answer (revert back to attendant if no answer).
    - 2) Trunk group busy.
    - 3) Station Recall to Attendant: In event of an incoming call being placed (in a hold status) prior to a station being dialed after a specified time this call must revert to the attendant.
  - d. Call transfer capability by attendant.
  - e. Automatic ring of called station with ring back tone provided to calling party.
  - f. Console designed for operation as far as 304.8 m (1,000 feet) from PBX equipment cabinets serviced by a 0.205 mm<sup>2</sup> (24 AWG) cable.
  - g. Attendant console must provide:
    - 1) Ability to enter any on-going voice call, regardless of whether call was connected through console, direct-in-dial, or originated as an intra-station call. Apply warning tone when attendant enters an on-going voice call.
    - 2) "Call-splitting" ability that permits attendant to exclude either outside or inside party when handling trunk calls.
    - 3) "Camp-on busy" feature, that permits attendant to place incoming voice calls on hold until called station number, is available. Tone burst to be applied to busy line to alert that a call is waiting.
    - 4) When busy line becomes free, the waiting call is automatically connected. If waiting call is not connected after a pre-determined time, the waiting call reverts to the attendant.
    - 5) Universal Night Answering Service: Provide ability for incoming calls to be answered from a location other than console.
    - 6) On-the-ear models attendant headsets, equipped with coiled cord, plug-in case amplifier, and quick disconnect for 10 attendants. Submit type of headsets to be provided.
    - 7) One supervisor plug-in handset with a push-to-talk button and a nine-foot cord.
    - 8) Dual tone multi-frequency dialing for attendant completion of incoming, outgoing, and intra-station calls.
  - h. Automated Attendant Features:
    - 1) Access from any instrument anywhere that provides DTMF signaling.
    - 2) Voice "PROMPTS" for every transaction.
    - 3) Introductory greeting.
    - 4) Ability of caller to enter extension of the person being called and connection to that extension or enter zero for connection to operator.
    - 5) Capability of providing caller with a directory and sub-directories of telephone numbers and ability to enter desired extension at any time while listening to directory.
- E. Cross-Connection System (CCS) Equipment: Breakout, termination connector (or bulkhead), patch panels, and connection assemblies, in addition to requirements of Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATION, must include the following:
- 1. Connector panels made of flat smooth 3 mm (1/8 inch) thick solid aluminum, custom designed, fitted and installed in cabinet.
  - 2. Bulkhead equipment connectors mounted on panel to enable cabinet equipment's signal, control, and coaxial cables to be connected through panel.
  - 3. Each panel color matching cabinet installed.
- F. Voice (or Telephone):

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1. 110-type punch blocks certified for Category 6 represent the minimum requirement for voice or telephone, and control wiring instead of patch panels. Category 6 IDC punch blocks (with internal RJ45 jacks) are acceptable for use in CCS. Secure punch block strips to OEM designed physical anchoring unit located on a wall in Demarc Room, Telephone Equipment Room, and TR. However, console, cabinet, rail, panel, etc. mounting is allowed at OEM recommendation and as accepted by COR. Punch blocks will not be accepted for Class II or 120 VAC power wiring.
  2. Technical Characteristics:
    - a. Number of Horizontal Rows: Minimum 100.
    - b. Number of Terminals per Row: Minimum 4.
    - c. Terminal protector: Required for each used or unused terminal.
    - d. Insulation Splicing: Required between each row of terminals.
- G. Fiber Optic and Analog Audio:
1. Product reference type must be tele wire, PUP-17 with pre-punched chassis mounting holes arranged in two horizontal rows. This panel can be used for fiber optic, audio, control cable, and Class II Low Voltage Wiring installations when provided with proper connectors. This panel will not be permitted for 120 VAC power connections.
  2. Technical Characteristics:
    - a. Height: Minimum two RUs, 89 mm (3.5").
    - b. Width: Minimum 484 mm (19 1/16"), EIA.
    - c. Number of Connections: Minimum 12 pairs.
    - d. Audio Service: Use RCA 6.35 mm (1/4 inch) Phono, XL or Barrier Strips, surface mounted with spade lugs (punch block or wire wrap type strips are acceptable alternates for barrier strips as long as system design is maintained).
    - e. Control Signal Service: Barrier strips surface mounted with spade lugs (punch block or wire wrap type strips are acceptable alternates for barrier strips as long as system design is maintained).
    - f. Low Voltage Power (Class II): Barrier strips with spade lugs and clear full length plastic cover, surfaced mounted.
    - g. Fiber Optic: "LC" Stainless steel, female.
- H. Mounting Strips and Blocks:
1. Barrier Strips:
    - a. Barrier strips are permitted for AC power, data, voice, and control cable or wires that accommodate size and type of audio spade (or fork type) lugs used with insulating and separating strips between terminals for securing separate wires in orderly fashion.
    - b. Provide barrier strips with audio spade lug, which is connected to an individual screw terminal on barrier strip at each cable or wire end.
    - c. Secure barrier strips to console, cabinet, rail, panel, etc. Do not connect 120 VAC power wires to signal barrier strips.
  2. Technical Characteristics:
    - a. Terminal Size: Minimum 6-32.
    - b. Terminal Count: Any combination.
    - c. Wire Size: Minimum 20 AWG.
    - d. Voltage Handling: Minimum 100 V.
    - e. Protective Connector Cover: Required for Class II and 120 VAC power connections.
  3. Solderless Connectors: Crimp-on insulated lug to fit 6-32 minimum screw terminal. Install fork connector using standard crimp tool.
  4. Furnish items for balancing and minimizing interference capable of passing telephone signals in frequency bands selected, in directions specified, with low loss, and high isolation and with minimum delay of specified frequencies and signals. Provide equipment necessary to meet requirements of this section and system performance standards.



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- I. Audio Monitor Panel:
  - 1. EIA standard panel for mounting in upper portion of 480 mm (19 inches) system equipment cabinet. This unit can be combined in system's Annunciating System and Electrical Supervision Panel, in order to achieve the minimum electrical supervision requirements of system. Refer to system technical data for additional required specifications.
  - 2. Technical Characteristics:
    - a. Monitor Speaker: A permanent magnet, 76 mm (3 inch) minimum diameter, and a monitor volume control.
    - b. Audiometer: Easy to read volume unit (vu) or similar meter with illuminated scale and meter calibrating control.
    - c. Channel Selector Switch: Six positions (Off, 1, 2, 3, 4, and Spare) which connect monitor speaker and VU meter to selected audio channel.
- J. Electrical Supervision Panel:
  - 1. Provide electrical supervision panel in system cabinet and Telephone Operator, locations and as designated on drawings compatible with system's Trouble Annunciation Panel and Audio Monitor Panel, to generate electrical and electronic supervising signals to continuously monitor operating condition for system, CSU, telephone instruments and interconnecting cable trunks. Generate an audible and visual signal when system's supervising system detects system, CSU, or trunk line is malfunctioning.
  - 2. Technical Characteristics:
    - a. Silence Button or Switch: Silence the audible signal; visual signal must continue until supervisory circuit indicates fault is corrected.
    - b. Visual Enunciators: Visually show amplifier and trunk-line unit or supervisory circuit is in fault condition.
- K. Telephone Instruments:
  - 1. Provide telephone instruments equipped with inductive capability to radiate a magnetic field required to activate hearing aid telecoil and to provide personnel, who use hearing aids, access to all telephones within facility.
  - 2. Provide station equipment consisting of standard single line instruments, patient bedside instruments, and multi-line digital electronic telephone instruments with digital display, of latest design.
  - 3. Provide telephone instruments except patient bedside phones, with a flash button (or equivalent feature button) with pre-determined timing feature to initiate consultation hold and other features normally initiated by operation of hook-switch. Flash button must be distinct from hook-switch.
  - 4. Attach laminated faceplate listing most common user features and their appropriate access codes to telephone instruments, except patient bedside phones. Faceplates can be an integral part of instrument housing or be an adhesive backed decal applied over tone pad area of housing at time of telephone set installation.
  - 5. Provide station instruments feature compatible and with transmission characteristics compatible with proposed system.
  - 6. Provide telephone instrument signaling by means of standard adjustable, buzzers, chimes, or electronic tone, unless otherwise specified.
  - 7. Single Line Instruments:
    - a. Single line instruments can be electronic or 2500-type analog phones.
    - b. Single line instruments used must be capable of supporting bridged cabling to allow a single phone number on multiple instruments without using multiple switch ports.
    - c. Single line instruments must be capable of supporting auxiliary equipment, such as amplified handsets; external chimes, light, or bells; and other similar equipment without using multiple switch ports.
  - 8. Multi-Line Instruments, Digital and Electronic - Features:

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- a. Digital read-out display and with minimum 14 programmable (lines or features) buttons.
  - b. Adjustable electronic tone to announce calls.
  - c. Detect an incoming call to multi-button instrument and provide an audible signal only on designated lines.
  - d. Lights to identify called line and remain illuminated for duration of call.
  - e. Associate telephone intercom systems with these instruments.
  - f. Equipment associated with intercom systems can require special features such as built in microphone and speaker. Provide secretaries with a means of announcing calls to offices with extensions or pickups on system. Identify provision of intercom systems during required data base survey and provide any required intercom systems.
  - g. This equipment must be capable of supporting auxiliary equipment, such as amplified handsets; external chimes, light, or bells; and other similar equipment. Use of analog switch ports to provide ringing voltage, if required, is acceptable and include these switch ports in equipped capacity.
  - h. Provide hot line telephones between two identified points equipped with two-way automatic ring and cut-off controlled by telephone hook-switch, i.e. when near-end hand set is removed from hook switch, far-end telephone rings until hand set is removed from hook-switch.
  - i. Configure speaker on hands-free telephone stations to be used as both transmitter and receiver to answer or initiate a call. These facilities to normally be used as a hot line between two points.
9. Patient Bedside Instruments - Features:
- a. Maintenance free, sanitized packet, and capable of supporting table top, side-rail, top bed-rail, or wall mounting. Provide each phone with minimum 15 feet of self-contained line cord.
  - b. At the discretion of the facility, patient bedside instruments can be discarded, cleaned for reuse, or given to the patient, as appropriate. Expected anticipated cost per instrument does not exceed ten dollars.
- L. Lightning Protection System: Provide totally external to building. The use of internal electrical wiring for lightning grounding systems will not be permitted.
1. Provide ground system, cabinets, racks, wire management systems, cable shields, etc. with copper wire run external to building and bond to grounding electrode conductor or inter system bonding termination. If these items are installed in an area not protected by lightning protection system, immediately notify COR of lightning strike hazard.
  2. Telephone, Data, Audio, and Coaxial Cable Lightning Protector:
    - a. Provide in-line device with screw type connectors to match coaxial and STP or UTP cable specified. Locate at each building entrance where each cable enters a building from the outside and grounded with stranded copper wire run external to building bonded to grounding electrode conductor to shunt high current surges to earth ground and have a minimal effect on quality of signal being received or transmitted. Provide protector made of non-corrosive metal and waterproof. Refer to system technical data for additional required specifications.
    - b. Technical Characteristics:
      - 1) Peak Pulse Power: 1500 W at 25 degrees C (77 degrees F).
      - 2) Protection Device: Gas Tube or as required by OEM.
      - 3) Dissipation: 1.0 Milliseconds (MS).
      - 4) Response Time: 5.0 nS.
      - 5) Connectors: As specified.
      - 6) Ground Wire: Minimum #6 AWG Stranded Copper, or as required by OEM and Government.

## 2.03 AUXILIARY SYSTEMS

- A. Interface system to Public Address System identified in Section 27 51 16, PUBLIC ADDRESS AND MASS NOTIFICATION SYSTEMS with technical instructions from COR.
  - 1. Provide console attendants direct access to selected zones and all zones paging. Provide attendant "priority access" to all zones.
  - 2. Provide selected station users access to appropriate zones, by dialing proper access.
  - 3. Provide required interface devices to PA. Provide a feature to prevent PA from being "locked up" by a user placing the system on hold or leaving receiver "off-hook".

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install according to following Industry Standards:
  - 1. NFPA Section 70, National Electrical Code (NEC), Article 517 and Chapter 7.
  - 2. NFPA Section 99, Health Care Facilities, Chapter 3-4.
  - 3. NFPA Section 101, Life Safety Code, Chapters 7, 12, and 13.
  - 4. Joint Commission Manual for Health Care Facilities, Life Safety and Support guidelines.
  - 5. These specifications.
  - 6. OEM installation, design, recommendations, and instructions.
- B. System Installation:
  - 1. Install suitable filters, traps, directional couplers, splitters, telephone outlets, and pads for minimizing interference and for balancing amplifiers and distribution systems.
  - 2. Connect passive equipment according to OEM's specifications to insure correct termination, isolation, impedance match and signal level balance at each telephone outlet.
  - 3. Terminate lines in a suitable manner to facilitate future expansion of system.
  - 4. Terminate vertical and horizontal copper and fiber optic //, and coaxial // lines in system, TER, MCR and TR equipment only.
  - 5. Install terminating resistors or devices on unused branches, outlets, and equipment ports of system designed for purpose of terminating fiber optic or twisted pair // , and coaxial // cables carrying telephone //, and analog video// signals in telephone // , and analog // systems.
  - 6. Install equipment outdoors in weatherproof enclosures with hinged doors and locks if equipment is not weatherproof. Provide a minimum of two keys for each lock.
  - 7. Install equipment indoors in metal cabinets with hinged doors and locks. Provide a minimum of two keys for each lock and VA Police Access Control System.
  - 8. Install a triplex outlet with modular jacks and stainless steel face plate for each telephone outlet shown on drawings. Provide appropriate modular jack (single or triplex) with appropriate face plate for each outlet location identified and verified on drawings.
  - 9. Install patient and wall telephone instruments on a single modular jack designed for wall telephone instruments and patient wall or PBPU installations.
  - 10. Install permanent telephone cables in conduit or an enclosed duct system. Obtain acceptance for installation, as determined by Government requirements, without conduit or enclosed duct system in cable tray or mechanically supported and separated from other signal cable systems.
  - 11. Where cables penetrate fire/smoke partitions, firewalls, or floors, coordinate installation of firestopping material of type accepted by COR.
  - 12. Install equipment in accordance with specifications for system as recommended by OEM.
  - 13. Replace ceiling tiles damaged during installation and maintenance service of cable and wire distribution system. Restore immediate areas damaged during system installation and maintenance service.
  - 14. Run all cross connects to established circuits during installation and maintenance service for contract life.
  - 15. Remove, on a daily basis, debris and scrap generated in conduct of work.

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- C. Rack and Cabinet Equipment Mounting:
1. Install rack mounted equipment on enclosure's equipment adjustable mounting racks with equipment normally requiring adjustment or observation mounted so operational adjustments can be conveniently made.
  2. Heavy Equipment:
    - a. Install heavy equipment using rack slides or rails allowing servicing from front of enclosure.
    - b. Install additional support to supplement front panel mounting screws for heavy equipment.
  3. Install cable slack to permit servicing by removal of equipment from front of enclosure.
  4. Install a color matched blank panel (spacer) of 44 mm (1-3/4 inches) high, between each piece of equipment (active or passive) to ensure adequate air circulation maintaining enclosure design for efficient equipment cooling and air ventilation.
  5. Provide 380 mm (15 inches) of front vertical space opening for additional equipment. Install color matched blank panels to cover any unused enclosure openings.
  6. Connect signal connector, patch, and bulkhead panels (i.e. PA, telephone, control, etc.) so that outputs from each source, device or system component to enter panel at top row of jacks, beginning left to right as viewed from front; these are to be called "inputs". Install connection to load, device or system component to exit panel at bottom row of jacks, beginning left to right as viewed from front; these are to be called "outputs".
  7. Mount equipment located indoors installed in metal racks or enclosures with hinged doors so it can be accessible for maintenance without interference to other nearby equipment.
  8. Fasten cables to equipment racks or enclosures in a manner that allows doors or access panels to open and close without disturbing or damaging cables.
  9. Install distribution hardware allowing access to connections for testing and provide room for doors or access panels to open and close without disturbing cables.
- D. Conduit, Cables And Wiring, Cable Tray, Raceways, Signal Ducts, Etc:
1. Conduits installed in accordance with Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS and Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING.
  2. Ensure that Telephone //, and PA // systems (as identified by NEC Section 517) are separated and protected from other systems.

### 3.02 FIELD QUALITY CONTROL

- A. Field Quality Control
1. Conduct an interim inspection of installed equipment in presence of COR, prior to proof of performance testing. Verify that equipment provided, adheres to installation requirements of this section.
  2. Install 50 percent of system equipment to include system, interface, origination and junction enclosures powered with permanent AC wiring, outlets, conduit and cables, before interim inspection can take place.
  3. Notify COR of estimated date contractor expects to be ready for interim inspection, at least seven working days before requested inspection date.
  4. Furnish results of interim inspection to COR and PM. If major or multiple deficiencies are discovered, COR can require a second interim inspection before permitting contractor to continue with system installation. SMCS 005OP2H3, (202) 461-5310, must be a part of this inspection team.
  5. COR, in conjunction with PE, will determine if an additional inspection is required, or if contractor will be permitted to proceed with the installation. In either case, re-inspection of deficiencies noted during the interim inspections are to be part of the proof of performance test. The interim inspection is not permitted to affect the system's completion date. Include test documents as part of system's record wiring diagrams.

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- B. Pretesting: Align and balance system, upon completing installation of the system. Pretest entire system.
- C. Pretesting Procedure: During system pretest, verify (utilizing the accepted spectrum analyzer and test equipment) that system is fully operational and meets the system performance requirements. Measure and record the aural carrier levels of each system telephone, at each of the following points in the system:
  - 1. Local Exchange Company (LEC) inputs.
  - 2. System inputs and outputs.
  - 3. TER, MCR and TR amplifiers, channel processor and converter inputs and outputs.
  - 4. System output S/NR for each telephone.
  - 5. Signal level at each interface point to distribution system, the last outlet on each trunk line plus all outlets installed as part of this contract.
  - 6. Submit four copies of recorded system pretest measurements along with pretest certification, to COR.
- D. Pretesting Certification: After pretesting system, notify COR that system is ready for proof of performance testing in presence of a SMCS 005OP2H3, (202) 461-5310, and COR, and that it meets requirements stated in construction documents. Submit notification of system readiness no later than twenty working days prior to scheduled Government proof of performance test. Failure of contractor to comply with these pretest requirements, automatically cancels the scheduled acceptance test.
- E. Acceptance Test:
  - 1. After system has been pretested and contractor has submitted pretest results and certification to COR, schedule an acceptance test date and give COR thirty days written notice prior to date acceptance test is expected to begin including expected length (in time) of test. Test in the presence of COR and an OEM certified representative. Test utilizing accepted test equipment to certify proof of performance. Verify that total system meets specified requirements under operating conditions, and complies with listed system performance standards.
  - 2. Make only those operator adjustments required to show proof of performance. Demonstrate and verify that installed system does comply with operational requirements. under operating conditions. Rate system as either acceptable or unacceptable at conclusion of the test. Failure of any part of system, that precludes completion of system testing and cannot be repaired within four hours, terminates the acceptance test of system.
  - 3. Declare entire system unacceptable if repeated failures result in a cumulative time of eight hours to effect repairs and retesting entire system at the convenience of Government.
- F. Acceptance Test Procedure:
  - 1. Mechanical and Physical Inspection:
    - a. COR will tour major areas where system and sub-systems are located, to ensure they are properly installed in place, and are ready for proof of performance acceptance testing. A system inventory including available spare parts must be taken at this time. Verify equipment to ensure appropriate UL certification labels are affixed.
    - b. Review system diagrams, record drawings, equipment manuals, AutoCAD files, intermediate and pretest results.
    - c. Failure of system to meet installation requirements of this specification terminates testing.
  - 2. Subsystem Operational Test:
    - a. After the mechanical and physical inspection, perform an operational test of each sub-system to verify that equipment is properly connected, interfaced and is operational to meet requirements of this section. If any sub-system is not functionally ready, that sub-system will be declared unacceptable and testing terminated. At this point, contractor is only permitted one hour to correct deficiencies.

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- b. Mutually agree with COR, at this time, to wait one hour or to commence testing of next sub-system.
- c. Repeated failures of sub-system testing or total system testing, that results in a cumulative time of four hours to effect repairs, is grounds for declaring entire system unacceptable and testing to be terminated. Reschedule retesting at convenience of Government.
3. Sub-system Performance Test: After operational test of each sub-system, verify that performance requirements and standards are met using test equipment. Verify there are no visible signal distortions, such as intermodulation, beats, etc. appearing on any received or generated telephone with A spectrum analyzer, signal level meter and bit error rate analyzer (BERT).
4. Total System Test: Commences only after system and sub-systems have been tested and accepted.
  - a. LEC Point of Demarcation: Check system outputs.
  - b. System: Test within 30 days following successful pretesting of system. In addition to compliance with technical characteristics and quantities of equipment specified herein, the final acceptance test provision that 30 continuous days of uninterrupted telephone service, must be completed prior to contractor being deemed in compliance with the contract.
    - 1) For purpose of final acceptance, telephone service is considered interrupted when failure of any contractor provided telephone equipment including batteries, results in an interruption of service. This includes a failure of more than 20 percent of any trunk group, 15 percent of any number group (15 or more stations), operator console, or telephone service to any area determined to be critical by Facility Director. Response time to restore service has bearing upon the term "interrupted service".
    - 2) To facilitate system acceptance test and to allow familiarization and training of government employees, activate system, including operator consoles, stations, and equipment a minimum 30 days prior to acceptance test date. Test installed equipment and circuits prior to acceptance by Government. During this "burn-in" period, de-bug the system. Make system available for in-house communications and demonstrate required features to facility staff. Government and contractor will make available trunks // and tie line circuits // are available to system during this "burn-in" period for testing.
5. Individual Item Test: COR can select individual items of equipment for detailed proof-of-performance testing to verify items selected meet or exceed minimum requirements of the specification.
6. Interface Cable Sub-system: Check minimum 75 percent of system outlets and interface points to ensure that system meets performance requirements.
  - a. Each sub-system interface, junction, and connection point or location will be checked.
  - b. Each distribution active and passive item of equipment, signal inputs and outputs must be tested.
7. Distribution Cable Plant Sub-system: For specific distribution testing instructions refer to Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING.
- G. Test Conclusion:
  1. At conclusion of acceptance test, using the generated punch list (or discrepancy list), Government will reschedule testing on deficiencies and shortages.
  2. If system is declared unacceptable without conditions, retest expenses are borne by the contractor.

### 3.03 SYSTEM STARTUP

- A. Provide personnel (switch technicians, installers, trainers, project manager, etc.) on premise for seven consecutive days after cutover to clear any malfunctions that develop, to assign/reassign any software features/COS, and conduct any additional training as required.

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- B. Connect telephone equipment located in TER to telecommunications grounding busbar.
- C. Provide system ground between system and interfaced systems such as PA system equipment chassis, etc.
- D. Ensure that other dedicated telecommunications systems applications within facility (i.e., pay stations, electro-writing equipment, facsimile etc.) that require space within TER, MCR and TRs, conduits, and cable pair are accommodated. Coordination between applicable parties is necessary to ensure accommodation of these systems.
- E. Verify all portions of system installation conform to local building and fire codes.

### 3.04 TRAINING

- A. Furnish services of an OEM trained and certified engineer or technician for two eight-hour classes to instruct designated facility maintenance personnel. Include cross connection, corrective, and preventive maintenance of telephone system and equipment.
- B. Furnish services of an OEM trained and certified engineer or technician, familiar with functions and operation of system and equipment, for two eight-hour periods to train designated facility IRM personnel. Instruct staff personnel in each area where system is installed under this contract. When multiple areas are involved, classes are to be grouped. Coordinate periods of training with COR to ensure all shifts receive required training. Include instructions utilizing hands-on operation and functions of the system.
- C. Before system can be accepted by Government, this training must be accomplished. Schedule training at the convenience of Facilities CO and Chief of Engineering Service.

### 3.05 MAINTENANCE

- A. Provide COR the ability to contact OEM's central emergency assistance maintenance center and request remote diagnostic testing and assistance in resolving technical problems at any time, during warranty period. Provide remote diagnostic testing and assistance capability to Government.
- B. Response Time during Warranty Period:
  - 1. Respond on-site, during the standard work week, to a routine trouble call within 24 hours of its report. A routine trouble is considered a trouble that causes a sub-system to be inoperable.
  - 2. Respond on-site to an emergency trouble call within four hours of its report. An emergency trouble is when failure:
    - a. Causes a system to be inoperable at any time.
    - b. Involves more than 20 voice circuits.
    - c. Is of a common control unit, power supply, signal generating device or attendant console.
  - 3. Respond on-site to a catastrophic trouble call within two hours of its report. System failure is considered a catastrophic trouble call.
    - a. If system failure cannot be corrected within six hours, provide an alternate CPU/Key System/mini- system equipped for a minimum of 100 main station lines, 10 CO trunks, 10 FTS access lines and two operator's consoles.
    - b. Install alternate system to provide emergency service to critical areas as determined by Facility Director within 12 hours (time to commence at end of the six hour trouble shooting period).
    - c. Provide to Facility Contracting Officer (CO), prior to cut-over of main telephone system, a pre-written program disk from programmable alternate system.
  - 4. Catastrophic trouble calls include failures affecting operation of critical emergency health care facilities (i.e., cardiac arrest teams, intensive care units, etc.) if so determined by Facility Director.
  - 5. Respond on-site to installation of station or equipment requests for service within:
    - a. Eight hours for emergency installations designated by Facility CO.

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- b. Three working days for routine installations designated by Facility CO.
- C. A standard work week is considered 8:00 A.M. to 5:00 P.M., Monday through Friday exclusive of Federal holidays.
- D. Provide compatible temporary equipment returning system or sub-system to full operational capability, until repairs are completed for any trouble that cannot be corrected within one working day.
- E. COR and Facility CO are contractor's reporting and contact officials for system trouble calls, during warranty period.
- F. Required On-Site Visits during Warranty Period:
  - 1. Visit, once every twelve weeks, to perform system preventive maintenance, equipment cleaning and operational adjustments to maintain system.
    - a. Arrange facility visits with COR or Facility CO prior to performing maintenance visits.
    - b. Perform preventive maintenance in accordance with OEM's recommended practice and service intervals during non-busy times agreed to by COR or Facility CO.
    - c. Provide preventive maintenance schedule to COR and Facility CO for approval.
    - d. Provide on-site replacement spare parts and equipment, plus test equipment, ensuring they meet OEM's minimum recommended spare parts stock sizing requirements for this specific system.
  - 2. Provide Facility CO a report itemizing each deficiency found and corrective action performed during each visit or official reported trouble call. Provide COR or Facility CO with sample copies of reports for review and approval at beginning of acceptance test. Minimum reports required:
    - a. Monthly summary of equipment and sub-systems serviced during warranty period to COR or Facility CO by fifth working day after end of each month. Describe services rendered, parts replaced, repairs performed and prescribe anticipated future needs of equipment and systems for preventive and predictive maintenance.
    - b. Separate log entry for each item of equipment and each sub-system of system listing dates and times of scheduled, routine, and emergency calls. Describe details of the nature and causes of each emergency call, emergency steps taken to rectify situation and specific recommendations to avoid such conditions in the future.
    - c. Include in Warranty GFE accepted by contractor, interfaced and installed in system; attach GFE List.

**END OF SECTION**



**SECTION 274131  
MASTER ANTENNA TELEVISION EQUIPMENT AND SYSTEMS**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

- A. This section specifies a complete and operating National Television Standards Committee (NTSC) High Definition (HDTV) Master Antenna Television (MATV) system, hardware and associated equipment for VA Clinic Building here-in-after referred to as the "facility".
- B. Provide complete system including antennae, antennae mounts, lightning protection, head-end equipment, RF amplification and distribution systems splitters, taps, cross-connection blocks including panels and associated hardware, telecommunication outlets (TCO), coaxial distribution wires, power supplies, cables, connectors, "patch" cables and internal communications system ground, required for reception and distribution of // cable // off-the-air HDTV // analog // signals.
  - 1. RF Service.
  - 2. Analog Video Service.
  - 3. Analog Audio Service.

**1.02 RELATED WORK**

- A. System Tests: Section 01 00 00, GENERAL REQUIREMENTS.
- B. Submittals (including samples, test reports, certificates, and manufacturers' literature): Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Sealant and caulking materials and their application around conduit penetrations through building envelope to prevent moisture migration into building: Section 07 92 00, JOINT SEALANTS.
- D. General electrical requirements that are common to more than one section in Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- E. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- F. Conduits for cables and wiring: Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- G. Low voltage cabling system infrastructure: Section 27 10 00, CONTROL, COMMUNICATION AND SIGNAL WIRING.
- H. Voice and data cable distribution system and associated equipment: Section 27 15 00, COMMUNICATIONS STRUCTURED CABLING.
- I. Nurse-Call and Code Blue Communication Systems and associated equipment: Section 27 52 23, NURSE CALL AND CODE BLUE SYSTEMS.

**1.03 COORDINATION**

- A. Coordinate with Facility Chief of Medical Media Production Service (MMPS) to install baseband analog RF, video, and audio interface cables and circuits from each TR to designated TCO locations and as shown on drawings.
- B. Coordinate with Facility Chief of MMPS to establish circuits throughout facility and provide proper test equipment to ensure that //analog RF//, video, and audio cables meet each OEM's standard transmission requirements, and ensure cables carry //analog// video and audio transmissions at required speeds, frequencies, and fully loaded bandwidth.

**1.04 SUBMITTALS**

- A. In addition to requirements of Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS, submit PDF electronic copies for each of the following:

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1. Provide site drawing showing system grounding electrode connections and routing of grounding electrode conductors.
2. Pictorial layout drawing of each antenna, mount, lead-in and lightning ground connections, antenna head end equipment room, Demarc Room, TR Equipment Room show termination cabinets, each distribution cabinet and rack, user TCO locations and wire management practices.
3. Engineering drawings of system, showing calculated signal levels at each input and output distribution point, used to determine proposed TCO values.
4. Calculated system layout drawing indicating cable types, amplifiers, taps, splitters, lengths of cable in "Tree", or "Bus" Topology.
5. Anticipated signal level at each coaxial cable TCO jack.
6. RF Cabling Requirements/Column Explanation:

Column	Explanation
FLOOR	Identify floor by number (i.e. 1st, 2nd, etc.)
TR ROOM NUMBER	Identify room, by number, from which cabling will be installed
TO FLOOR TR	Identify building, by number or location, to which cabling will be installed
NUMBER OF CONDUCTORS	Identify the number of conductors in each run of RF cable
INSTALLATION METHOD	Identify the method of installation
NOTES	Identify note numbers for special features or equipment
BUILDING MTR	Identify building by number or title //

7. Analog Video (and Audio) Cabling Requirements/Column Explanation:

Column	Explanation
FROM BUILDING	Identify building, by number or location, from which cabling will be installed
TR ROOM NUMBER	Identify the room, by number, from which cabling will be installed
TO BUILDING IMR	Identifies building, by number or title, to which cabling will be installed
TR ROOM NUMBER	Identify the room, by number, to which cabling will be installed
NUMBER OF CONDUCTORS	Identify the number of conductors in each run of cable
INSTALLATION METHOD	Identify method of installation
NOTES	Identify a note number for special features or equipment
BUILDING MTR	Identifies the building by number or title

8. Antenna Signal Survey:
  - a. Submit RF signal survey from recognized industry source, derived mathematically from fixed information, showing radiated and received RF signals at project and approximation of signal levels expected using given antenna.
    - 1) Record findings on a geographic map with facility residing in its center and outline coverage locations, radiating in a 360-degree pattern. Depict primary, secondary, marginal and out of range areas of operation by different colors for each frequency of operation.

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- 2) Include longitude and latitude of facility along with elevation above mean sea level using a Geostationary System (GPS) portable device.
  - 3) An on-site survey, using actual transmitting and receiving equipment of type contractor is submitting, is an acceptable alternative to recognized industry source.
9. List of test equipment required by Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- B. Certifications:
1. Submit certification from OEM that MATV installation supervisor and maintenance provider are authorized representatives of OEM. Include each individual's legal name, address and OEM credentials in the certification that includes the most recent approval date.
  2. Submit pre-acceptance certification in accordance with test procedures.
- C. Needs Assessment Report: Provide a summary report of the needs assessment meeting conducted with nursing manager of each unit, as required by this section.
- D. Provide sample copy of report format to be used for trouble calls; obtain COR approval of sample report before beginning total system acceptance test.

#### 1.05 WARRANTY

- A. In addition to compliance with FAR clause 52.246-21 provide OEM warranty documents certifying each item of equipment conforms to specifications and OEM installation recommendations.
- B. Warrant system picture fidelity equal to that received from cable provider and other modulated channels.

### PART 2 PRODUCTS

#### 2.01 PERFORMANCE AND DESIGN CRITERIA

- A. Design Criteria:
1. Coordinate features to provide components forming an integrated system. Match components and interconnections for optimum performance of specified functions.
  2. Provide system with capacity to increase quantity of TCOs by 40 percent above indicated without adding any internal or external components or main trunk cable conductors.
  3. Distribute HDTV television signal to MATV TCOs to permit simple connection of A/53 ATSC Digital Television Standard Parts 1-6 HDTV receivers.
  4. Deliver at MATV TCOs HDTV //Analog// television channel signals.
  5. Provide reception quality at each MATV TCO exceeding that received in area with individual antennas. Deliver minimum +6.0 dBmv (2,000 microvolts across 75 Ohms) and maximum of +20 dBmv (20,000 microvolts) for each HDTV channel at each MATV TCO.
  6. Only employ interfacing methods accepted by OEM and VACO's AHJ (SMCS 005OP2H3). Selected interface or interconnecting methods require physical and mechanical connections, matching signal, voltage, processing levels and impedance that provides described signal levels and quality.
  7. Interface // telephone, // RED, // Nurse Call, // PA, // and \_\_\_\_\_ // systems with system only as accepted by AHJ (SMCS 005OP2H3).
  8. Provide passive distribution equipment to meet or exceed -80 dB radiation shielding specifications // and provide screw type audio connectors//.
  9. Terminate trunk, branch, and interconnecting cables and unused equipment ports or taps with terminating resistors designed for RF, audio, and digital cable systems without adapters.
  10. Utilize microprocessor components for signaling and programming circuits and functions. Use non-volatile system program memory, or protected from erasure during power outages for a minimum of 24 hours.

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- a. Provide UPS for system (including each distribution cabinet/point) to allow normal operation and function in event of an AC power failure or during input power fluctuations for a minimum of 30 minutes.
  11. Use coaxial cable connections recommended by cable OEM and approved by equipment OEM for coaxial cable distribution points and RF transmission lines.
    - a. Utilize barrier terminal screw type connectors, minimum at base band cable systems.
    - b. Crimp type connectors installed with a ratchet type installation tool are acceptable alternative if cable dress, pairs, shielding, grounding, connections and labeling are same as barrier terminal strip connectors.
    - c. Tape of any type, wire nuts or solder type connections are not permitted.
  12. Utilizing LAN/WAN cable systems for control, management and distribution of equipment and distribution of MATV signals is not permitted. Connect system ensuring NFPA Critical Care and Life Safety Circuit separation guidelines are satisfied. Connections to Telephone and LAN/WAN systems are not permitted.
  13. Telephone cable to distribute MATV signals, carrying system or sub-system AC or DC voltage is not permitted.
  14. Audio Level Processing: Provide control location equipment to ensure system produces audio channel capacity identified on drawings at each TV/speaker.
  15. Provide weather-resistant equipment listed by National Recognized Testing Laboratory (NRTL) for installation outdoors or in damp locations.
- B. Performance Criteria:
1. RF Service:
    - a. "Off air" RF High Definition (HDTV) //or Analog // Television service// (considered to be at RF (below 900 MHz in frequency bandwidth). RF television systems require backbone coaxial cable, from antenna farm to antenna head end room, and to each TR and distribution coaxial cable to each HDTV outlet location.
    - b. Isolation (outlet-outlet): 14 dB.
    - c. Impedance: 75 Ohms, unbalanced.
    - d. Signal Level: 10 dBmV, +/- 5.0 dBmV.
    - e. Bandwidth: Minimum 6.0 MHz per channel fully loaded.
  2. Analog Video Service: Baseband below 100 MHz in frequency bandwidth.
    - a. Isolation (outlet-outlet): Minimum 24 dB.
    - b. Impedance: 75 Ohm, unbalanced.
    - c. Output Level: 1.0 V peak to peak (P-P), for 87.5 percent depth of Modulation (Mod).
    - d. Diff Gain:  $\pm 1.0$  dB at 87.5 percent Mod.
    - e. Diff Phase:  $\pm 1.5$  at 87.5 percent Mod.
    - f. Signal to Noise (S/N) ratio: Minimum 44 dB.
    - g. Hum Modulation: -55 dB.
    - h. Return Loss: Maximum -14 dB or 1.5 Voltage Standing Wave Ratio (VSWR).
    - i. Bandwidth: Minimum 6.0 MHz per channel, fully loaded.
  3. Analog Audio Service: is baseband below 10 MHz in frequency bandwidth. Analog audio circuits require separate audio connectors and video connectors even though both are considered baseband signals. Each TCO has multiple 600 (or 120) Ohm BAL line pairs.
    - a. Impedance: 600 Ohm, BAL
    - b. Input Level: Minimum 59 mV RMS.
    - c. Output Level: 0 dBm.
    - d. S/N ratio: Minimum 55 dB.
    - e. Hum Modulation: Minimum -50 dB.
    - f. Return Loss: Maximum -14 dB (or 1.5 VSWR).
    - g. Isolation (outlet-outlet): Minimum 24 dB.
    - h. Frequency Bandwidth: Minimum 100 Hz – 10 KHz.

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- C. Provide accessories and miscellaneous equipment for a complete and operating HDTV // analog // system.
- D. Equipment:
  - 1. Modular type rated for continuous duty.
  - 2. Provide NRTL Listed equipment by OEM that is a commercial business enterprise manufacturing items of equipment and which:
    - a. Maintains replacement parts for equipment in stock,
    - b. Maintains engineering drawings, specifications, and operating manuals for equipment.
    - c. Published and distributed descriptive literature and equipment specifications on equipment submitted 30 days prior to Invitation for Bid.
- E. For protection from input power surges and to ensure noise is not induced into circuits, provide noise filters and surge protectors for each equipment interface, distribution and head end cabinet, control console, and local and remote amplifier locations. Provide lightning/surge suppression of the antenna farm and ground per NEC article 810.
- F. Provide stainless steel, //anodized aluminum// or AHJ (SMCS 005OPO2H3) accepted faceplates.

**2.02 ANTENNA EQUIPMENT (OR ANTENNA FARM)**

- A. Provide antennae and associated equipment to distribute the following over the air television channels to MATV distribution system:
  - a. Channels per local over the air broadcast station availability.

Virtual Channel	Physical RF Channel	Call Sign	Network
23.1	36	KOBI-DT1	NBC
34.1	30	KLSR-DT1	Fox
9.1	27	KEZI-DT1	ABC
11.1	11	KCBY-DT1	CBS
10.1	23	KOPB-DT1	PBS

- B. Provide heavy duty antennas and supports designed to withstand local wind loads and adverse environmental conditions.
  - 1. Provide molded rubber weather boots //or thick coats of waterproofing compound// to protect connectors from moisture. Tape will not be allowed.
- C. Antenna:
  - 1. Provide ruggedized Broadband UHF antenna made of noncorrosive material cut to narrowest bands in which specified channels fall.
  - 2. Provide one spare UHF antenna per channel specified.
  - 3. Technical Characteristics:
    - a. Gain: 11 dB.
    - b. F/B Ratio: 20 dB.
    - c. VSWR: 1.5:1 Maximum.
    - d. Connectors: "F" or "N"
    - e. Impedance: 75 Ohm.
    - f. Wind Speed: Capable to withstand minimum 200 km/h (125 MPH) winds without damage along with 6.4 mm (1/4 inch) radial ice.
- D. Preamplifier:
  - 1. Low noise UHF Broadband amplification.
  - 2. Enclosed in weatherproof aluminum housings.
  - 3. Capable of mounting on antenna mast.
  - 4. Operating temperature: minus 30 to plus 60 degrees Celsius (minus 20 to plus 140 degrees Fahrenheit).

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5. Integral NRTL labeled lightning surge protection.
6. Provide one spare UHF antenna preamplifier.
7. Technical Characteristics:
  - a. Response:  $\pm 1.0$  dB across 10 MHz.
  - b. Noise Figure: Maximum 6 dB.
  - c. Gain: Minimum 22 dB.
  - d. Return Loss: 14 dB.
  - e. Connectors: "F".
  - f. Impedance: 75 Ohm.
- E. Antenna Mast:
  1. Material: Thick-walled hot dipped galvanized steel.
  2. Minimum Inside Diameter: 38 mm (1-1/2 inches).
  3. Lightning Protection: Provide clamp for bonding #4 AWG stranded copper conductor to earth ground.
  4. Wind Load: 200 km/h (125 MPH).
  5. Environmental Conditions: withstand 6.4 mm (1/4 inch) radial ice.
- F. Lightning Arrestor: Noncorrosive metal grounding block assembly bonding antenna coaxial cable shield to earth ground for lightning protection with #4 AWG stranded copper conductor.
- G. Antenna Tower:
  1. Material: Heavy duty tower minimum 32 mm (1-1/4 inches) outside diameter hot dipped galvanized steel tubing built on an equilateral triangle design with cross bracing throughout.
  2. Lightning protection: Provide clamp for #10 AWG stranded copper conductor bond to earth ground.
  3. Wind load: 200 km/h (125 MPH).
  4. Environmental conditions: Able to withstand 6.4 mm (1/4 inch) radial ice.

### 2.03 HEAD END EQUIPMENT AND ROOM

- A. RF Amplifier, Broadband:
  1. Rack mount.
  2. AGC controlled with adjustable gain.
  3. NRTL listed for continuous operation with lightning protection.
  4. No out of band channel interference (noise) output without signal input.
  5. Provide integral aural carrier reducer (ACR).
    - a. Response:  $\pm 1$  dB across 6 MHz.
    - b. Noise Figure: Maximum 6 dB.
    - c. Output Capability: Minimum +60 dBmV.
    - d. Gain: Minimum 40 dB.
    - e. Skirt Sharpness: -25 dB  $\pm$  0 MHz (Channel Center).
    - f. AGC Range: Maximum 1 dB output change for  $\pm 10$  dB.
    - g. Return Loss: 14 dB.
    - h. Connectors: "F".
    - i. Impedance: 75 Ohm.
- B. Channelized Agile Audio/Video Modulators:
  1. Provide factory-assembled channelized audio/video modulator for each outbound local origination channel to create a line up from off-air // and cable feeds// for coaxial cable distribution.
  2. Utilize triple output modulator to conserve rack space.
  3. Provide Emergency Alert System (EAS) program switching so when EAS is invoked, all QAM and IP output programs are interrupted to display EAS message.
  4. NRTL listed for continuous operation.

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5. Technical Characteristics:
  - a. Channel Bandwidth: 6 MHz  $\pm$  dB
  - b. Noise Figure: Maximum 14 dB.
  - c. Conversion Gain: 6 dB.
  - d. Spurious Outputs: -55 dB.
  - e. Oscillator Stability:  $\pm$  25 KHz.
  - f. Connectors: "F".
  - g. Impedance: 75 Ohm.
- C. Channel Processor:
  1. Agile analog heterodyne processor to accept one Analog RF input (CATV sub-band channels T7-T13, CATV standard channels 2-135, VHF channels 2-13, and UHF channels 14-69) and deliver one Analog RF output on an unused channel (CATV standard channels 2-135) without causing interference.
  2. NRTL listed.
  3. Supports Closed Captioning (EIA-608).
  4. Rack mount.
  5. Technical Characteristics:
    - a. Response:  $\pm$  1.0 dB across 6 MHz
    - b. Noise Figure: VHF 9 dB Max. UHF 12 dB Max.
    - c. Oscillator Stability:  $\pm$  25 KHz
    - d. AGC: Maximum 1 dB output change for  $\pm$  10 dB input change.
    - e. Adjacent Video Carrier.
    - f. Out of band Products: -55 dB.
    - g. Rejection: 40 dB.
    - h. Output Capability: 42 dBmV
    - i. Gain: Minimum 40 dB.
    - j. Connectors: "F".
    - k. Impedance: 75 Ohm.
- D. Active Mixer/Combiner:
  1. Provide one output from a minimum of 6 isolated inputs.
  2. Provide three spare inputs.
  3. Rack mount.
  4. Technical Characteristics:
    - a. Frequency Range: 50 - 300 MHz.
    - b. Gain: Minimum 15 dB.
    - c. Output: Minimum 52 dB.
    - d. Isolation: 25 dB.
    - e. Connectors: "F".
    - f. Impedance: 75 Ohm.
- E. Single Channel Bandpass Filter:
  1. Permit adjacent channel operation.
  2. Rack mount.
  3. Technical Characteristics:
    - a. Insertion Loss: Maximum 8 dB.
    - b. Skirt Selectivity:
      - 1) Upper Adj; Picture Carrier: -30 dB
      - 2) Lower Adj Sound Carrier: -40 dB
    - c. Return Loss: 14 dB.
    - d. Bandpass: 6 MHz  $\pm$  1 dB.
    - e. Connectors: "F".
    - f. Impedance: 75 Ohm.

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- F. Notch filters:
1. High 'Q' Trap.
  2. Rack mount.
  3. Technical Characteristics:
    - a. Signal Rejection: 40 dB.
    - b. Insertion Loss: Maximum 3 dB.
    - c. Connectors: "F".
    - d. Impedance: 75 Ohm.

## 2.04 DISTRIBUTION EQUIPMENT

- A. Distribution Devices:
1. Distribution Amplifiers:
    - a. Description: Broadband, very low distortion, cable television system quality, HDTV distribution amplifier.
    - b. Characteristics:
      - 1) Frequency Range: 49MHz to 1,000MHz.
      - 2) Channel Loading: 150.
      - 3) Flatness: +/-0.75dB.
      - 4) Gain: 32dB.
      - 5) Output Level: +40dBmV.
      - 6) Gain Control Range: 10dB.
      - 7) Slope Control Range: 8dB.
      - 8) Plug in Equalizers: As needed.
      - 9) Attenuator Options: As needed.
        - (a) Programming: Minimum 35 HDTV channels.
        - (b) Gain of the Preamplifier: 32dB, with an output level of 48dBmV for each HDTV channel processed.
        - (c) Amplifier Module: Hybrid push-pull.
        - (d) Gain and Slope Control Ranges: 8dB and 9dB, respectively.
- B. Combiners:
1. Provide 8-port passive combiner for combining RF signals into one main trunk run for distribution to building locations.
  2. Bandwidth of Combiner: 0 to 1,000 MHz.
- C. Cable:
1. Provide RG-6, RG-11, or appropriate hardline minimum 13 mm (1/2 inch) coaxial cable to achieve specified signal level.
    - a. Provide RG-11 or 13 mm (1/2 inch) hardline coaxial cable for runs over 45.72 m (150 feet) in length.
    - b. Provide plenum //riser// rated coaxial cable with a nominal characteristic impedance of 75 Ohms throughout entire frequency spectrum utilized in this system.
  2. Sweep-test and return-loss test each reel of cable, over frequency range 50 MHz to 750 MHz, at manufacturer prior to shipping.
  3. Trunk Cable:
    - a. Description: 13 mm (1/2 inch), semi-rigid coax, riser rated.
    - b. Maximum Attenuation:
      - 1) 92 dB/100ft at 700 MHz.
      - 2) dB/100ft at 1000 MHz.
      - 3) Impedance: 75 Ohm.
  4. RG6 Cable:
    - a. Description: RG6 double shielded cable //CMR or// CMP Rated
    - b. Attenuation:
      - 1) dB/100ft at 50 MHz.



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- 2) dB/100ft at 1000 MHz.
- 3) Impedance: 75 Ohm.
5. General Purpose Analog RF:
  - a. Size:
    - 1) Minimum coaxial cable size RG-6 type (or equal).
    - 2) Increase size (i.e. RG-11, 13 mm (1/2 inch), 19 mm (3/4 inch), etc.) to meet system design signal level.
    - 3) Use for baseband signals as approved by OEM.
  - b. Technical Characteristics:
    - 1) Impedance: 75 Ohm, unbalanced.
    - 2) Center Conductor: 20 AWG, solid or stranded copper, or copper plated steel or aluminum.
    - 3) Dielectric: Cellular polyethylene.
    - 4) Shield Coverage: 95 percent, copper braid.
    - 5) Connector Type: BNC or UHF.
    - 6) Attenuation:
      - (a) Frequency 10 kHz: Maximum 0.20 dB/30.5 M (100 ft.)
      - (b) Frequency 100 kHz: Maximum 0.22 dB/30.5 M (100 ft.)
      - (c) Frequency 1 MHz: Maximum 0.25 dB/30.5 M (100 ft.)
      - (d) Frequency 4.5 MHz: Maximum 0.85 dB/30.5 M (100 ft.)
      - (e) Frequency 10 MHz: Maximum 1.40 dB/30.5 M (100 ft.)
      - (f) Frequency 100 MHz: Maximum 5.00 dB/30.5 M (100 ft.)
6. RG11 Cable:
  - a. Description: RG11 cable //CMR or// CMP Rated.
  - b. Attenuation:
    - 1) 90 dB/100ft at 50 MHz.
    - 2) dB/100ft at 1000 MHz.
    - 3) Impedance: 75 Ohm.
- D. Line Splitters:
  1. Provide low-radiation line splitters with a flat frequency response from 50 MHz to 1,000 MHz. Provide units of a hybrid design with a 75-ohm match on input and outputs and a VSWR no greater than 1.4:1.
  2. Provide two-way line splitters with signal loss of not more than 3.5 dB at each output.
  3. Provide four-way line splitters with signal loss of not more than 7.2 dB at each output.
  4. Terminate unused splitter outputs with 75-Ohm terminations.
- E. RF signal splitters:
  1. Frequency Range: 5MHz to 900MHz.
  2. Outputs: 2, 3, 4 and 8.
  3. Splitter Loss: less than 12 dB.
  4. RFI Shielding: 120 dB.
- F. HDTV Outlets:
  1. Provide HDTV outlets at each location shown. Install outlets in 10.2 cm (4 inch) square, 5.1 cm (2 inch) deep minimum flush electrical boxes.
  2. Incorporate provisions in the network to prevent 60 Hz AC or DC feedback into distribution lines.
  3. Outlets:
    - a. Frequency Range: 10 MHz to 900 MHz, minimum
    - b. Insertion Loss: less than 1.0 dB at any frequency within designated frequency range for a 17 dB isolation network.
    - c. Back-matched from 10 to 1,000 MHz.
    - d. One F-type or BNC connector on front and two F-type or BNC connectors on rear.

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- e. Minimum Isolation Value between any Two Outlets: 24 dB.
- G. Taps:
  - 1. Description: Directional coupler type taps.
  - 2. Rated for installation in TR or accessible area of cable tray.
  - 3. Frequency Range: 5 MHz to 900 MHz.
  - 4. Outputs: 2, 4 and 8.
- H. Wall plates and Bulkhead Connectors:
  - 1. Provide wall plates for termination of CATV signals at television sets.
  - 2. Impedance: 75 Ohms.
  - 3. Frequency Band: SUB/VHF/CATV-HDTV/UHF.
- I. Combiners, Traps, and Filters; and Passive Devices such as Splitters, Couplers, "Patch" Cables, or Devices:
  - 1. Use coaxial cable connections recommended by cable OEM and approved by system OEM for coaxial cable distribution points and RF transmission lines.
    - a. Utilize barrier terminal screw type connectors minimum at base-band cable systems.
    - b. Crimp type connectors installed with a ratchet type installation tool are an acceptable alternative if cable dress, pairs, shielding, grounding, connections and labeling are provided same as barrier terminal strip connectors.
    - c. Tape of any type, wire nuts, or solder type connections are not permitted.
  - 2. Analog RF terminating panels:
    - a. "Patch" Type:
      - 1) cm (19 inches) EIA/ECA 310-E rack dimensions.
      - 2) Minimum 12 double female "F" connector rows.
      - 3) Expansion capability of a maximum of 24 double row "F" slots that can be field activated.
      - 4) In a lockable cabinet or enclosure. //Stacking of "patch" panels is permitted if installation guidelines are met. //
  - 3. "Patch" Cords:
    - a. Analog RF:
      - 1) Provide a connection cable for each TCO analog RF connector in system with 10 percent spares. Provide analog RF connection cable of length to connect analog RF instrument to TCO analog RF jack.
      - 2) Technical Characteristics:
        - (a) Length: Minimum 1.8M (6 ft.).
        - (b) Cable: Minimum flexible RG-6.
        - (c) Connector: "F" male on each end.
- J. Analog Video:
  - 1. Provide a connection cable for each TCO analog video jack in system with 10 percent spares. Provide analog video connection cable of length to connect analog video instrument to TCO analog RF jack.
  - 2. Technical Characteristics: //
    - a. Length: Minimum 1.8M (6 ft.).
    - b. Cable: Minimum flexible RG-59/U.
    - c. Connector: BNC male on each end.
- K. System Connectors:
  - 1. Solderless (Forked Connector):
    - a. Crimp-on coupling for quick connect/disconnect of wires or cables.
    - b. Designed to fit wire or cable.
    - c. Insulated and color-coded connector barrel.
    - d. Technical Characteristics:
      - 1) Impedance: As required.

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- 2) Working Voltage: 500 V.
2. Multipin:
  - a. Crimp-on coupling for quick connect/disconnect of wires or cables.
  - b. Designed to fit wire or cable.
  - c. Enclosed and shielded housing.
  - d. Secure to cable group by screw type compression sleeves.
  - e. Technical Characteristics:
    - 1) Impedance: As required.
    - 2) Working Voltage: 500 V.
    - 3) Number of Pins: As required, Minimum 25 pairs.
3. "BNC" Type:
  - a. Bayonet locking coupling for quick connect/disconnect of coaxial cable/terminations.
  - b. Crimp-on (twist on are acceptable) connector designed to fit coaxial cable.
  - c. Technical Characteristics:
    - 1) Impedance: 50 or 75 Ohms, unbalanced.
    - 2) Working Voltage: 500 V.
4. "F" Type Connectors:
  - a. Coaxial cable connectors and connector inserts designed to provide maximum performance with cable to be used.
  - b. Hex type crimp or a "Snap and Seal" type connectors. Use Housing to housing (KS to KS) type or 90-degree type connectors where specified by OEM.
  - c. Screw type coupling for quick connect/disconnect of coaxial cable/terminations.
  - d. Crimp-on connector designed to fit coaxial cable with integral 12.7 mm (1/2 inch) ferrule.
  - e. Technical Characteristics:
    - 1) Impedance: 75 Ohms, unbalanced.
    - 2) Working Voltage: 500 V.
  - f. Coaxial cables connected with head end quality 360 degree F or BNC connectors as applicable, meeting or exceeding standard industry and cable manufacture's specifications.
- L. Terminators:
  1. Coaxial:
    - a. Description: 75-Ohm terminator.
    - b. Metal-housed precision types in frequency ranges selected. Screw-on type that has low VSWR when installed and proper impedance to terminate system unit or coaxial cable.
    - c. Technical Characteristics:
      - 1) Frequency: 0-1 GHz.
      - 2) Power Blocking: As required.
      - 3) Return Loss: 25 dB.
      - 4) Connectors: Minimum "F", "BNC".
      - 5) Impedance: 75 Ohms, unbalanced.
      - 6) DC blocking.
      - 7) Bandwidth: 50 MHz-890 MHz.
- M. Mounting Strips and Blocks:
  1. Barrier Strips for AC Power, and Control Cable or Wires:
    - a. Accommodate size and type of audio spade (or fork type) lugs used with insulating and separating strips between terminals for securing separate wires in an orderly fashion.
    - b. Provide each cable or wire end with an audio spade lug, connected to individual screw terminal on barrier strip.
    - c. Surface secured to a console, cabinet, rail, panel, etc.

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- d. 120 VAC power wires are not permitted to be connected to signal barrier strips.
- 2. Technical Characteristics:
  - a. Terminal Size: Minimum 6-32.
  - b. Terminal Count: Any combination.
  - c. Wire size: Minimum 20 AWG.
  - d. Voltage Handling: Minimum 100 V.
  - e. Protective Connector Cover: Required for Class II and 120 VAC power connections.
- N. Coaxial Cable Kit: Coaxial connectors, cable tying straps, heat shrink tabbing, hangers, clamps, etc., required to accomplish neat and secure installation.
  - 1. Solderless Connectors: Install crimp-on connector using a standard F connector crimping tool.
  - 2. Cables: Connectors designed for specific size cable being used and installed with OEM's approved installation tool. Typical system cable connectors include; but, are not limited to F, N, BNC, etc.
- O. Communication Ground System: provide this system to conform to Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

**2.05 TOPOLOGY "TREE", OR "BUS"**

- A. Provide Analog RF coaxial cable distribution system in a "home run" configuration from each associated riser TR to identified locations and as shown on drawings. /
- B. Provide an analog RF coaxial cable trunk system. Provide a minimum of two coaxial cables between head end and each riser patch panel to comprise an individual circuit as designated and as shown on drawings. Provide Additional analog RF coaxial cables as system design dictates and as shown on drawings.
- C. Connect analog RF coaxial trunk-line systems between each riser "bottom" row of "F" connectors and terminate on TR patch panel "top" row of "F" connectors. Provide minimum of six coaxial cables in riser trunk-line system.
- D. Connect analog RF coaxial cabling systems between each TR and terminate on patch panel "top" row of "F" connectors. Additionally terminate each horizontal distribution analog RF coaxial cable on "bottom" row of "F" connectors of same panel.
- E. Provide dedicated analog RF coaxial cables from "bottom" row of "F" connectors of appropriate TR patch panel where "input" connections were made, to each floor TCO in "home run" configuration and in quantity to accommodate TCO's served by TR distribution cable system. Provide analog RF coaxial cables for each TCO circuit and as shown on drawings.
- F. Connect one end of each coaxial RF cable to a female "F" connector at each TCO, and at other locations on drawings, and opposite end to a bottom row "F" connector on patch panel in TR serving the area. Contractor is not to "interconnect" backbone with coaxial RF distribution cables or provide active RF distribution equipment.
- G. Analog RF Service: Broadcast RF, or "off air television", analog service is RF below 900 MHz in frequency bandwidth. RF television circuits require a single coaxial cable plant from head end to each TR location.
  - 1. Isolation (outlet-outlet): 14 dB
  - 2. Impedance: 75 Ohms, Unbalanced.
  - 3. Signal Level: 10 dBmV + 5.0 dBmV.
  - 4. Bandwidth: 6.0 MHz per channel, fully loaded.
- H. Closed Circuit Analog Video Service:
  - 1. Analog video service is baseband (below 100 mHz in frequency bandwidth).
  - 2. Analog video circuits require a separate analog video from audio connector. /
  - 3. Minimum operating parameters over each installed analog video circuit:
    - a. Impedance: 75 Ohm, unbalanced.
    - b. Output Level: 1.0 V peak to peak (P-P), for 87.5 percent depth of Modulation (Mod).

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- c. Diff Gain:  $\pm 1$  dB at 87.5 percent Mod.
  - d. Diff Phase:  $\pm 1.5$  at 87.5 percent Mod.
  - e. Signal to Noise (S/N) Ratio: Minimum 44 dB.
  - f. Hum Modulation: -55 dB.
  - g. Return Loss: Maximum -14 dB (or 1.5 Voltage Standing Wave Ratio VSWR).
  - h. Isolation (outlet-outlet): Minimum 24 dB.
  - i. Bandwidth: Minimum 6.0 MHz per channel, fully loaded.
- I. Closed Circuit Analog Audio Service:
    1. Analog audio service is baseband (below 10 MHz in frequency bandwidth).
    2. Analog audio circuits require separate audio connectors and video connectors even though both are baseband signals.
    3. Each TCO has multiple 600 (or 120) Ohm BAL line pairs, therefore analog audio circuits can be designated to one of the provided pairs of UTP or STP for each TCO.
    4. Minimum operating parameters of analog audio circuit (NOT TELEPHONE VOICE):
      - a. Impedance: 600 Ohm, BAL.
      - b. Input Level: Minimum 59 mV RMS.
      - c. Output Level: 0 dBm.
      - d. S/N ratio: Minimum 55 dB.
      - e. Hum Modulation: Minimum -50 dB.
      - f. Return Loss: Maximum -14 dB (or 1.5 VSWR).
      - g. Isolation (outlet-outlet): Minimum 24 dB.
      - h. Frequency Bandwidth: Minimum 100 Hz - 10K Hz.
  - J. Interface analog RF "F", video "BNC", and audio "XL" jacks to appropriate patch panels in associated TR. Do not cross-connect analog cables in TRs to analog equipment.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Coordinate with cabling trade contractor locations of faceplates and faceplate openings for MATV back boxes.
- B. Coordinate with cabling trade contractor locations of MATV equipment in the Telecommunications Rooms.
- C. Before beginning work, verify location, quantity, size and access for the following:
  1. Isolated ground AC power circuits required for equipment.
  2. Emergency and auxiliary AC power generator requirements.
  3. Pull boxes, wall boxes, wire troughs, conduit stubs and other related infrastructure for systems.
  4. System components provided by others.
  5. Overhead supports and rigging hardware installed by others.
- D. Immediately notify COR and General Contractor of discrepancies.
- E. Needs Assessment:
  1. Provide a one-on-one meeting with nursing manager of each unit affected by installation of new HDTV MATV system.
  2. Review floor plans, educate nursing manager with functions of the equipment that is being provided, and gather details specific to individual units; coverage and priorities of calls; staffing patterns; and other pertinent details that affect system programming and training.

#### **3.02 INSTALLATION**

- A. General:
  1. Install for ease of operation, maintenance, and testing.
  2. Install work neatly, plumb and square and in a manner consistent with standard industry practice.

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3. Install system to prevent direct pickup of signals from building structure and follow FCC requirements regarding low radiation or interference of RF signals.
  4. Protect work from dust, paint and moisture as dictated by site conditions.
  5. Contractor is responsible for protection of work during construction phase up until final acceptance by Government.
  6. Install equipment according to OEM's recommendations. Provide any hardware, adaptors, brackets, rack mount kits or other accessories recommended by OEM for correct assembly and installation.
  7. Secure equipment firmly in place, including equipment racks, system cables, etc.:
    - a. Install supports, mounts, fasteners, attachments and attachment points to support their loads with a safety factor of 5:1 or better.
    - b. Do not impose weight of equipment on supports provided for other trades or systems.
    - c. Suspended equipment or associated hardware must be certified by OEM for overhead suspension.
  8. Locate overhead ceiling-mounted equipment as shown on drawings, with minor changes not to exceed 12 inches in any direction.
    - a. Mount transformers securely to brackets or enclosures using screws.
    - b. Adjust torsion springs as needed to securely support assembly.
  9. Install Analog RF coaxial cable distribution systems in a "home run" configuration from each associated riser TR to identified locations and as indicated on drawings.
  10. Coordinate finishes for any exposed work such as plates, racks, panels, speakers, etc. with design professional, Government and 005OP3B.
  11. Coordinate cover plates with field conditions. Size and install cover plates to cover spaces between back boxes and surrounding wall.
  12. Do not allow cable to leave or enter boxes without cover plates installed. Where cover plates are not fitted with connectors, provide grommeted holes in size and quantity required.
- B. Equipment Racks:
1. Fill unused equipment mounting spaces with blank panels or vent panels. Match color to equipment racks.
  2. Provide security covers for devices not requiring routine operator control.
  3. Follow manufacturer's recommendations regarding ventilation space between amplifiers. Provide adequate ventilation space between equipment for cooling. Provide vent panels and cooling fans for operation of equipment within OEM specified temperature limits.
  4. Provide insulated connections of electrical raceway from equipment racks.
  5. Provide continuous raceway and conduit for cable with no more than 40 percent fill between wire troughs and equipment racks. Ensure systems are mechanically separated from each other in wireway.
- C. Wiring Practice:
1. Comply with requirements for raceways and boxes specified in Division 26, Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
  2. Where raceway is conduit, install wiring of differing classifications in separate conduits. Where raceway is to be in an enclosure (e.g. rack, tray, wire trough, utility box, install wiring of differing classifications, sharing same enclosure, with mechanical partition and separate by at least 4 inches. Where Wiring of differing classifications must cross, cross wires perpendicular to one another.
  3. Do not splice cabling anywhere along entire length of run. Ensure cables are insulated and shielded from each other and from the raceway for entire length of run.
  4. Do not pull wire through any enclosure where a change of raceway alignment or direction occurs. Do not bend wires to less than radius recommended by manufacturer.
  5. Replace entire length of run of any wire or cable that is damaged or abraded during installation. There are no acceptable methods of repairing damaged or abraded wiring.

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6. Use wire pulling lubricants suitable for cable jacket and do not exceed pulling tension recommended by OEM.
  7. Use grommets around cut-outs and knock-outs where conduit or chase nipples are not installed.
  8. Do not use tape-based or glue-based cable anchors.
  9. Bond shields and drain wires to ground.
  10. Terminate field wiring entering equipment racks as follows:
    - a. Provide ample service loops at harness break-outs and at plates, panels and equipment. Loops must be of length to allow plates, panels and equipment to be removed for service and inspection.
    - b. Where terminal blocks are not designed for rack mounting, utilize 19 mm (3/4 inch) plywood or 3 mm (1/8 inch) thick aluminum plates/blank panels as a mounting surface. Do not mount on bottom of rack.
    - c. Employ permanent strain relief for any cable with an outside diameter of 25 mm (1 inch) or greater.
  11. Make connections using rosin-core solder or mechanical connectors appropriate to application.
    - a. For crimp-type connections, use only tools that are specified by manufacturer for the application.
    - b. Use only insulated spade lugs on screw terminals sized to fit wire gauge; do not exceed two lugs per terminal.
    - c. Twist-on wire connectors or electrical tape connections are not permitted for any application.
- D. Cable Installation:
1. Support cable on maximum 122 cm (4 feet) centers. Acceptable means of cable support are cable tray and conduit (EMT, Flexible Metallic Tubing, and Communications Raceway). Attach cable bundles loosely to cable trays with plenum rated hook and loop straps. Tie wraps are not permitted as a means to bundle.
  2. Run cables parallel to walls.
  3. Do not lay cables on top of luminaires, ceiling tiles, mechanical equipment, or ductwork. Maintain minimum 61 cm (2 feet) clearance from shielded electrical apparatus.
  4. Test cables after the total installation is complete. Test results must document cables pass test requirements and levels. Remedy cabling problems or defects to pass testing, including installation of new cable as required.
  5. Terminate ends of cables on both ends, per industry and OEM's recommendations.
  6. Provide proper temporary protection of cable after pulling is complete and until final dressing and terminations are complete. Do not leave cable lying on floor. Bundle and tie cables up off of the floor until ready to terminate.
  7. Cover end of overall jacket with a minimum 25 mm (1 inch) length of transparent heat-shrink tubing. Cut unused insulated conductors minimum 51 mm (2 inches) past heat-shrink, fold back over jacket and secure with cable-tie. Cut unused shield/drain wires minimum 51 mm (2 inches) past heat shrink and serve as indicated below.
  8. Cover shield/drain wires with heat-shrink tubing extending back to overall jacket. Extend tubing 6 mm (1/4 inch) past end of unused wires, fold back over jacket and secure with cable tie.
  9. For each solder-type connection, cover bare wire and solder connection with heat-shrink tubing.
  10. Terminate conductors; no cable can contain unterminated elements. Make terminations only at outlets and terminals.
  11. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables cannot be spliced.
  12. Bundle, lace, and train conductors to terminal points without exceeding OEM's limitations on bending radii. Install lacing bars and distribution spools.

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13. Cold-Weather Installation: Bring cable to room temperature without using heat lamps before de-reeling.
  14. Install cable without passing through structural members or in contact with pipes, ducts, or potentially damaging items.
- E. Labeling:
1. Permanently label outlets, connectors, jacks, electronics and other equipment.
  2. Engrave and paint fill patch panel labels using minimum 3 mm (1/8 inch) high lettering and contrasting paint.
  3. For rack-mounted equipment, use engraved Lamacoid labels with white minimum 3 mm (1/8 inch) high lettering on black background. Label front and back of rack-mounted equipment.
  4. Where multiple pieces of equipment reside in same rack group, label each indicating to which room, channel, outlet locations, etc. they correspond.
  5. Permanently label cables at each end, including intra-rack connections. Cover labels by same, transparent heat-shrink tubing covering end of overall jacket. Alternatively, machine printed labels including a clear protective wrap can be used.
  6. Label racks with contractor's name no more than once on each continuous set of racks; do not label wall plates or portable equipment with contractor's name.
  7. Ensure each piece of OEM equipment has permanently attached NRTL Label indicating service the equipment is to perform. Equipment not bearing NRTL marks will not be permitted as part of system.
- F. Antenna Installation: Mount antennae on masts attached to building walls, penthouse walls or other solid parts of building free of all obstructions.
1. Fasten mounting brackets with lag bolts or expansion anchors 9.5 mm (3/8 inch) diameter. Attachments to mortar or grout joints not permitted.
  2. For building and penthouse walls, attach masts with three or more brackets spaced at no less than 450 mm (18 inch) intervals.
  3. Obtain approval from COR prior to installation of an antenna or mast directly on roof or penthouse.
  4. Do not install more than three antennas on a single mast. Install additional mast as required maintain proper spacing between masts and between antennas on each mast.
  5. Securely tighten mounting hardware, antenna hardware and terminals.
  6. Orient antennas to ensure optimum signal to noise ratio.
  7. Ensure assembly will survive winds of 200kph (125MPH).
- G. Protect HDTV / Analog / network devices during unpacking and installation by wearing electrostatic discharge (ESD) wrist straps tied to chassis ground for prevention of electrical shock.
- H. Cutting and Patching:
1. Keep work area clear of debris and clean area daily at completion of work.
  2. Patch and paint any wall or surface that has been disturbed by execution of this work.
  3. Provide any additional cutting, drilling, fitting or patching, not indicated as provided by others, to complete work or to make its parts fit together.
  4. Do not damage or endanger a portion of work of the Government or separate contractors by cutting, patching, excavation or otherwise altering such construction. Prior to cutting or otherwise altering such construction obtain written consent of COR and of such separate contractor. Do not unreasonably withhold from COR or a separate contractor, contractor's consent to cutting or otherwise altering MATV work.
  5. Where coring of in-place concrete is required, // including coring indicated under unit prices, // clearly identify location of such coring in the field and have location accepted by COR prior to commencement of coring.
- I. Fireproofing:



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1. Where MATV cables penetrate rated walls, floors and ceilings, fireproof openings to restore rating.
  2. Provide conduit sleeves for cables that penetrate rated walls.
  3. After cabling installation is complete, install fire proofing material in and around conduit sleeves and openings to restore rating. Install fire proofing material thoroughly and neatly.
  4. Seal floor and ceiling penetrations. Use only materials and methods that preserve the integrity of fire stopping system and its rating.
- J. Grounding:
1. Ensure lightning protection system is in place per Section 26 41 00, FACILITY LIGHTNING PROTECTION. If not present, contact COR immediately for instructions.
  2. Communication Ground: provide this system in accordance with Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS, and:
    - a. Bond cable shields and equipment to ground to eliminate shock hazard and to minimize ground loops, common mode returns, noise pickup, cross talk, and other impairments.
    - b. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.
    - c. Do not connect system ground to building's external lightning protection system.
    - d. Do not "mix grounds" of different systems. Do not use electrical system conductors for ground.
- K. Cleaning: Refer to Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

### 3.03 FIELD QUALITY CONTROL

- A. Tests:
1. Refer to Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
  2. HDTV MATV System is NFPA listed; therefore, testing provisions are the minimum to be performed and provided by contractor and warranted by OEM.
- B. Interim Inspection:
1. After completion of 25-30 percent of installation of head end cabinets and equipment, one wing of HDTV MATV outlets //and interconnection to corresponding Nurse Call (Code Blue) System // Patient Head Wall Units // and prior to any further work, this portion of system must be pretested, inspected, and certified.
  2. Verify equipment provided adheres to installation requirements of this section.
  3. Include a full operational test.
  4. Inspection and test must be conducted by a factory-certified contractor representative and witnessed by COR.
  5. Conduct an identical inspection between 65 and 75 percent of system construction phase, at direction of COR.
  6. Check each item of installed equipment to insure appropriate NRTL label.
  7. Confirm marking of cables, faceplates, patch panel connectors and patch cords.
  8. Perform inspection tests via continuity measurements on factory reels and provide results along with manufacturer certification for factory reel tests. Remove failed cable reels from project site upon test failure.
  9. Notify COR, in writing, of estimated date the contractor expects to be ready for interim inspection, at least 20 working days before requested inspection date so interim inspection does not affect system completion date.
  10. Provide results of interim inspection to COR. If major or multiple deficiencies are discovered, COR can require a second interim inspection before permitting system installation to continue.
  11. Do not proceed with installation until COR determination of additional inspection. In either case, re-inspection of deficiencies noted during interim inspections must be part of proof

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of performance test.

- C. Pretesting:
1. Upon completing installation of system, align, balance, and pretest entire system under full operating conditions.
  2. Pretesting Procedure:
    - a. During system pretest verify, utilizing accepted test equipment, system is operational and meets performance requirements.
    - b. Pretest and verify specification requirements are met and system functions are operational, no unwanted aural effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise, etc. are present. At a minimum, pretest each of the following locations:
      - 1) Antennae.
      - 2) Lightning Grounds.
      - 3) Head-End.
      - 4) Local and Remote Control Units/Enunciation Panels.
      - 5) Networked locations.
      - 6) System interface locations (i.e.PA, Nurse Call, etc.).
      - 7) System trouble reporting.
      - 8) UPS operation.
      - 9) Primary and emergency AC power requirements.
        - (a) Extra auxiliary generator requirements.
    - c. Provide recorded system pretest measurements and certification that system is ready for formal acceptance test to COR.
- D. Acceptance Test:
1. After system has been pretested and contractor has submitted pretest results and certification to COR, schedule an acceptance test dates and give COR 30 days written notice prior to date acceptance test is expected to begin. Include expected duration of time for test with notification of acceptance test.
  2. Test only in the presence of COR and AHJ (SMCS 005OP2H3).
  3. Test utilizing test equipment to certify proof of performance.
  4. Verify that total system meets requirements of this specification.
- E. Verification Tests:
1. Test copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield. Test cables after termination.
  2. Perform same tests appropriate to each coaxial cable accepted for use in system.
- F. Performance Testing: Test every video distribution outlet for clear picture and sound.
1. At each outlet with television, select each channel and view picture on television. Observe active channels. Verify picture is clear with no visual presence of interference of any kind and no audible variance in volume level between channels.
  2. Perform tests utilizing signal level meter to determine values and record.
- G. Total System Acceptance Test: Perform verification tests for copper cabling systems after complete video distribution system and workstation outlet are installed.
1. Acceptance tests are performed on a "go-no-go" basis.
  2. Only perform operator adjustments required to show proof of performance.
  3. Demonstrate and verify that installed system complies with requirements of specification under operating conditions.
  4. Obtain rating of system as either acceptable or unacceptable from COR at conclusion of test.
  5. Failure of any part of system that precludes completion of system testing, and which cannot be repaired in four hours, is cause for terminating acceptance test of system. Repeated failures that result in a cumulative time of eight hours to affect repairs can cause

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entire system to be declared unacceptable and require retest of entire system at the convenience of Government.

- H. Acceptance Test Procedure:
1. Physical and Mechanical Inspection:
    - a. Coordinate COR tour of major areas where system and sub-systems are installed to ensure they are operationally ready for proof of performance testing. Provide system inventory including available spare parts for COR to verify and check each item of installed equipment has appropriate NRTL certification labels affixed during tour.
    - b. Formally inventory and review system diagrams, record drawings, equipment manuals, Telecommunications Infrastructure Plant (TIP) AutoCAD files, intermediate, and pretest results formally inventoried and reviewed.
    - c. Failure of system to meet installation requirements of this specification is grounds for terminating testing.
  2. Operational Test:
    - a. After physical and mechanical inspection, verify //antennae//, head end terminating and control equipment meets performance requirements outlined herein. Utilize spectrum analyzer and signal level meter to accomplish this requirement.
    - b. Following antennae and head end equipment test, connect local and remote control unit to the head end equipment's output. Test tap to ensure there are no signal distortions such as intermodulation, data noise, popping sounds, erratic system functions, on any function.
    - c. Check distribution system at each interface, junction, and distribution point, first, middle, and last leg to verify that HDTV MATV video, audio and control signals meet system performance standards.
    - d. Functionally test HDTV MATV outlets utilizing contractor's accepted hospital grade TV receiver and spectrum analyzer.
    - e. //Check red system and volume stepper switches to ensure proper operation of pillow speaker, volume stepper and red system.//
    - f. Once these tests have been completed, test each installed sub-system function as a unified, functioning and fully operating system.
    - g. Individual Item Test: COR can select individual items of equipment for detailed proof of performance testing until 100 percent of system has been tested and found to meet specification.
- I. Acceptable Test Equipment:
1. Utilize test equipment with calibration tag of an acceptable calibration service dated not more than 12 months prior to test. Furnish test equipment list that includes make and model number of the following type of equipment as a minimum:
    - a. Spectrum Analyzer.
    - b. Signal Level Meter.
    - c. Volt-Ohm Meter.
    - d. Oscilloscope.
    - e. Pillow Speaker Test Set (Pillow Speaker with appropriate load and cross connections instead of the set is acceptable).
- J. Non-Conforming Work:
1. Government, OEM and contractor must agree to results of Acceptance Test, create consensus punch lists, and reschedule testing for technical deficiencies and equipment shortages.
  2. Any retests needed to reach agreement and validate results of punch lists, or to establish compliance with these specifications, are at contractor's expense.
  3. These requirements must be met for contract compliance and Government acceptance of system.

**3.04 TRAINING**

- A. Provide thorough training of facility's engineering and maintenance staff on operation, performance and preventative maintenance of system.
- B. Schedule training at convenience of facility's Chief Engineer.
- C. MATV system will not be accepted without completion of training.
- D. Provide the following training at locations provided by Government:
  - 1. Minimum eight hours for system operation and performance no less than 48 hours prior to opening of facility.
  - 2. Minimum eight hours for system preventative maintenance no less than 24 hours before opening of facility.

**3.05 MAINTENANCE**

- A. Accomplish the following minimum requirements during one year warranty period:
  - 1. Response Time:
    - a. Standard work week is 8:00 A.M. to 5:00 P.M., Monday through Friday exclusive of Federal holidays.
    - b. Respond and correct on-site trouble calls, during standard work week:
      - 1) Routine trouble call within one working day. Routine trouble is an inoperable system outlet.
      - 2) Emergency trouble call within six hours. Emergency trouble is an inoperable subsystem or distribution point.
- B. Provide report itemizing each deficiency found and corrective actions performed, to COR, for each trouble call.

**END OF SECTION**

**SECTION 275116**  
**PUBLIC ADDRESS AND MASS NOTIFICATION SYSTEMS**

**PART 1 - GENERAL**

**1.01 SECTION SUMMARY**

- A. Work covered by this document includes design, engineering, labor, material and products, equipment warranty and system warranty, training and services for, and incidental to, the complete installation of new and fully operating National Fire Protection Association (NFPA) – Life Safety Code 101.3-2 (a) Labeled and (b) Listed Emergency Service Public Address System (PAS) and associated equipment (hereinafter referred to as the System) in approved locations indicated on the contract drawings. These items shall be tested and certified capable of receiving, distributing, interconnecting and supporting PAS communications signals generated local and remotely as detailed herein.
- B. Work shall be complete, Occupational Safety and Health Administration (OSHA), National Recognized Testing Laboratory (NRTL – i.e. Underwriters Laboratory [UL]) Listed and Labeled; and VA Central Office (VACO), Telecommunications Voice Engineering (TVE 005OP3B) tested, certified and ready for operation.
- C. The System shall be delivered free of engineering, manufacturing, installation, and functional defects. It shall be designed, engineered and installed for ease of operation, maintenance, and testing.
- D. The term “provide”, as used herein, shall be defined as: designed, engineered, furnished, installed, certified, and tested, by the Contractor.
- E. Specification Order of Precedence: In the event of a conflict between the text of this document and the Project’s Contract Drawings outlined and/or cited herein; THE TEXT OF THIS DOCUMENT TAKES PRECEDENCE. HOWEVER, NOTHING IN THIS DOCUMENT WILL SUPERSEDE APPLICABLE EMERGENCY LAWS AND REGULATIONS, SPECIFICALLY NATIONAL AND/OR LOCAL LIFE AND PUBLIC SAFETY CODES. The Local Fire Marshall and/or VA Public Safety Officer are the only authorities that may modify this document’s EMERGENCY CODE COMPLIANCE REQUIREMENTS, on a case by case basis, in writing and confirmed by VA’s PM, RE and TVE-005OP3B. The VA PM is the only approving authority for other amendments to this document that may be granted, on a case by case basis, in writing with technical concurrences by VA’s RE, TVE-005OP3B and identified Facility Project Personnel.
- F. The Original Equipment Manufacturer (OEM) and Contractor shall ensure that all management, sales, engineering and installation personnel have read and understand the requirements of this specification before the system is designed, engineered, delivered and provided. The Contractor shall furnish a written statement attesting this requirement as a part of the technical submittal that includes each name and certification, including the OEMs.

**1.02 RELATED SECTIONS**

- A. 01 33 23 – Shop Drawings, Product Data and Samples.
- B. 07 84 00 – Firestopping.
- C. 27 05 11 – Requirements for Communications Installations.
- D. 27 05 26 – Grounding and Bonding for Communications Systems.
- E. 27 05 33 – Raceways and Boxes for Communications Systems.
- F. 27 10 00 – Control, Communication and Signal Wiring.
- G. 27 11 00 – Communications Cabling Interface and Equipment Rooms Fittings.
- H. 27 15 00 – Horizontal and Vertical Communications Cabling Equipment and Systems.
- I. 27 31 00 – Voice Communications Switching and Routing Equipment and System.

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J. 28 13 16 – Physical Access Control System and Database Management

**1.03 DEFINITIONS**

- A. Provide: Design, engineer, furnish, install, connect complete, test, certify and warranty.
- B. Work: Materials furnished and completely installed.
- C. Review of contract drawings: A service by the engineer to reduce the possibility of materials being ordered which do not comply with contract documents. The engineer's review shall not relieve the Contractor of responsibility for dimensions or compliance with the contract documents. The reviewer's failure to detect an error does not constitute permission for the Contractor to proceed in error.
- D. Headquarters Technical Review, for National and VA communications and security, codes, frequency licensing, standards, guidelines compliance:
  - 1. Office of Telecommunications
  - 2. Special Communications Team (005OP2B)
  - 3. 1335 East West Highway – 3rd Floor
  - 4. Silver Spring, Maryland 20910
  - 5. (O) 301-734-0350, (F) 301-734-0360
- E. Engineer: //XXXXXXXX//
  - 1. //XXXXXXXX//
  - 2. //XXXXXXXX//
  - 3. //XXXXXXXX//
  - 4. //XXXXXXXX//
- F. Owner: //XXXXXXXX//
- G. General Contractor (GC): //XXXXXXXX//
- H. Contractor: Radio Contractor; you; successful bidder

**1.04 REFERENCES**

- A. The installation shall comply fully with all governing authorities, laws and ordinances, regulations, codes and standards, including, but not limited to:
  - 1. United States Federal Law:
    - a. Departments of:
      - 1) Commerce, Consolidated Federal Regulations (CFR), Title 15 – Under the Information Technology Management Reform Act (Public Law 104-106), the Secretary of Commerce approves standards and guidelines that are developed by the:
        - (a) Chapter II, National Institute of Standards Technology (NIST – formerly the National Bureau of Standards). Under Section 5131 of the Information Technology Management Reform Act of 1996 and the Federal Information Security Management Act of 2002 (Public Law 107-347), NIST develops – Federal Information Processing Standards Publication (FIPS) 140-2—Security Requirements for Cryptographic Modules.
        - (b) Chapter XXIII, National Telecommunications and Information Administration (NTIA – aka 'Red Book') Chapter 7.8 / 9; CFR, Title 47 Federal communications Commission (FCC) Part 15, Radio Frequency Restriction of Use and Compliance in "Safety of Life" Functions & Locations
      - 2) FCC - Communications Act of 1934, as amended, CFR, Title 47 – Telecommunications, in addition to Part 15 – Restrictions of use for Part 15 listed Radio Equipment in Safety of Life / Emergency Functions / Equipment/ Locations (also see CFR, Title 15 – Department of Commerce, Chapter XXIII – NTIA):

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- (a) Part 15 – Restrictions of use for Part 15 listed Radio Equipment in Safety of Life / Emergency Functions / Equipment/Locations.
  - (b) Part 58 – Television Broadcast Service.
  - (c) Part 90 – Rules and Regulations, Appendix C.
  - (d) Form 854 – Antenna Structure Registration.
- 3) Health, (Public Law 96-88), CFR, Title 42, Chapter IV Health & Human Services, CFR, Title 46, Subpart 1395(a)(b) JCAHO “a hospital that meets JCAHO accreditation is deemed to meet the Medicare conditions of Participation by meeting Federal Directives:”
- (a) All guidelines for Life, Personal and Public Safety; and, Essential and Emergency Communications.
- 4) Labor, CFR, Title 29, Part 1910, Chapter XVII - Occupational Safety and Health Administration (OSHA), Occupational Safety and Health Standard:
- (a) Subpart 7 - Definition and requirements (for a NRTL – 15 c’s, for complete list, contact ([http://www.osha.gov/dts/otpca/nrtl/faq\\_nrtl.html](http://www.osha.gov/dts/otpca/nrtl/faq_nrtl.html)):
  - (b) UL:
    - (1) 44-02 – Standard for Thermoset-Insulated Wires and Cables.
    - (2) 65 – Standard for Wired Cabinets.
    - (3) 83-03 – Standard for Thermoplastic-Insulated Wires and Cables.
    - (4) 467-01 – Standard for Electrical Grounding and Bonding Equipment
    - (5) 468 – Standard for Grounding and Bonding Equipment.
    - (6) 486A-01 – Standard for Wire Connectors and Soldering Lugs for Use with Copper Conductors
    - (7) 486C-02 – Standard for Splicing Wire Connectors.
    - (8) 486D-02 – Standard for Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations.
    - (9) 486E-00 – Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors.
    - (10) 493-01 – Standard for Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable.
    - (11) 514B-02 – Standard for Fittings for Cable and Conduit.
    - (12) 1069 – Hospital Signaling and Nurse Call Equipment.
    - (13) 1333 – Vertical (Riser) Fire Rating.
    - (14) 1449 – Standard for Transient Voltage Surge Suppressors.
    - (15) 1479-03 – Standard for Fire Tests of Through-Penetration Fire Stops.
    - (16) 1863 – Standard for Safety, Communications Circuits Accessories.
    - (17) 2024 – Standard for Optical Fiber Raceways.
    - (18) 60950-1/2 – Information Technology Equipment – Safety.
    - (19) Canadian Standards Association (CSA): same tests as for UL.
    - (20) Communications Certifications Laboratory (CCL): same tests as for UL.
    - (21) Intertek Testing Services NA, Inc. (ITSNA formerly Edison Testing Laboratory [ETL]): same tests as for UL.
  - (c) Subpart 35 – Compliance with NFPA 101 – Life Safety Code.
  - (d) Subpart 36 - Design and construction requirements for exit routes.
  - (e) Subpart 268 - Telecommunications.
  - (f) Subpart 305 - Wiring methods, components, and equipment for general use.
- 5) Department of Transportation, CFR, Title 49 (Public Law 89-670), Part 1, Subpart C – Federal Aviation Administration (FAA):
- (a) Standards AC 110/460-ID & AC 707 / 460-2E – Advisory Circulars for Construction of Antenna Towers.
  - (b) Forms 7450 and 7460-2 – Antenna Construction Registration.

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- 6) Veterans Affairs (Public Law No. 100-527), CFR, Title 38, Volumes I & II:
  - (a) Office of Telecommunications:
    - (1) Handbook 6100 – Telecommunications.  
Spectrum Management FCC & NTIA Radio Frequency Compliance and Licensing Program.  
Special Communications Proof of Performance Testing, VACO Compliance and Life Safety Certification(s).
  - (b) Office of Cyber and Information Security (OCIS):
    - (1) Handbook 6500 - Information Security Program.
    - (2) Wireless and Handheld Device Security Guideline Version 3.2, August 15, 2005.
  - (c) VA's National Center for Patient Safety – Veterans Health Administration Warning System, Failure of Medical Alarm Systems using Paging Technology to Notify Clinical Staff, July 2004.
  - (d) VA's Center for Engineering Occupational Safety and Health, concurrence with warning identified in VA Directive 7700.
  - (e) Office of Construction and Facilities Management (CFM):
    - (1) Master Construction Specifications (PG-18-1).
    - (2) Standard Detail and CAD Standards (PG-18-4).
    - (3) Equipment Guide List (PG-18-5).
    - (4) Electrical Design Manual for VA Facilities (PG 18-10), Articles 7 & 8.
    - (5) Minimum Requirements of A/E Submissions (PG 18-15):  
Volume B, Major New Facilities, Major Additions; and Major Renovations, Article VI, Paragraph B.  
Volume C - Minor and NRM Projects, Article III, Paragraph S.  
Volume E - Request for Proposals Design/Build Projects, Article II, Paragraph F.
    - (6) Mission Critical Facilities Design Manual (Final Draft – 2007).
    - (7) Life Safety Protected Design Manual (Final Draft – 2007).
    - (8) Solicitation for Offerors (SFO) for Lease Based Clinics – (05-2009).
- b. Federal Specifications (Fed. Specs.):
  - 1) A-A-59544-00 - Cable and Wire, Electrical (Power, Fixed Installation).
2. United States National Codes:
  - a. American Institute of Architects (AIA): Guidelines for Healthcare Facilities.
  - b. American National Standards Institute/Electronic Industries Association/Telecommunications Industry Association (ANSI/EIA/TIA):
    - 1) 568-B - Commercial Building Telecommunications Wiring Standards:
      - (a) B-1 – General Requirements.
      - (b) B-2 – Balanced twisted-pair cable systems.
      - (c) B-3 - Fiber optic cable systems.
    - 2) 569 - Commercial Building Standard for Telecommunications Pathways and Spaces.
    - 3) 606 – Administration Standard for the Telecommunications Infrastructure of Communications Buildings.
    - 4) 607 – Commercial Building Grounding and Bonding Requirements for Telecommunications.
    - 5) REC 127-49 – Power Supplies.
    - 6) RS 160-51 – Sound systems.
    - 7) RS 270 – Tools, Crimping, Solderless Wiring Devices, Recommended Procedures for User Certification.
    - 8) SE 101-A49 – Amplifier for Sound Equipment
    - 9) SE 103-49 – Speakers for Sound Equipment



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- c. American Society of Mechanical Engineers (ASME):
    - 1) Standard 17.4 – Guide for Emergency Personnel.
  - d. American Society of Testing Material (ASTM):
    - 1) D2301-04 - Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape.
  - e. Building Industries Communications Services Installation (BICSI):
    - 1) All standards for smart building wiring, connections and devices for commercial and medical facilities.
    - 2) Structured Building Cable Topologies.
    - 3) In consort with ANSI/EIA/TIA.
  - f. Institute of Electrical and Electronics Engineers (IEEE):
    - 1) SO/TR 21730:2007 - Use of mobile wireless communication and computing technology in healthcare facilities - Recommendations for electromagnetic compatibility (management of unintentional electromagnetic interference) with medical devices.
    - 2) 0739-5175/08/©2008 IEEE – Medical Grade – Mission Critical – Wireless Networks.
    - 3) C62.41 – Surge Voltages in Low-Voltage AC Power Circuits.
  - g. NFPA:
    - 1) 70 - National Electrical Code (current date of issue) – Articles 517, 645 & 800.
    - 2) 75 - Standard for Protection of Electronic Computer Data-Processing Equipment.
    - 3) 77 – Recommended Practice on Static Electricity.
    - 4) 99 - Healthcare Facilities.
    - 5) 101 - Life Safety Code.
    - 6) 1600 – Disaster Management, Chapter 5.9 – Communications and Warning
- 3. State Hospital Code(s).
  - 4. Local Town, City and/or County Codes.
  - 5. Accreditation Organization(s):
    - a. a. Joint Commission on Accreditation of Hospitals Organization (JCAHO) – Section VI, Part 3a – Operating Features.

### 1.05 QUALIFICATIONS

- A. The OEM shall have had experience with three (3) or more installations of systems of comparable size and complexity with regards to type and design as specified herein. Each of these installations shall have performed satisfactorily for at least one (1) year after final acceptance by the user. Include the names, locations and point of contact for these installations as a part of the submittal.
- B. The Contractor shall submit certified documentation that they have been an authorized distributor and service organization for the OEM for a minimum of three (3) years. The Contractor shall be authorized by the OEM to pass thru the OEM’s warranty of the installed equipment to VA. In addition, the OEM and Contractor shall accept complete responsibility for the design, installation, certification, operation, and physical support for the System. This documentation, along with the System Contractor and OEM certifications must be provided in writing as part of the Contractor’s Technical submittal.
- C. The Contractor’s Communications Technicians assigned to the System shall be fully trained, qualified, and certified by the OEM on the engineering, installation, operation, and testing of the System. The Contractor shall provide formal written evidence of current OEM certification(s) for the installer(s) as a part of the submittal or to the RE before being allowed to commence work on the System.
- D. The Contractor shall display all applicable national, state and local licenses.

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- E. The Contractor shall submit copy (s) of Certificate of successful completion of OEM's installation/training school for installing technicians of the System's PA equipment being proposed.

#### **1.06 CODES AND PERMITS**

- A. Provide all necessary permits and schedule all inspections as identified in the contract's milestone chart, so that the system is proof of performance tested and ready for operation on a date directed by the Owner.
- B. The contractor is responsible to adhere to all codes described herein and associated contractual, state and local codes.
- C. The Contractor shall display all applicable national, state and local licenses and permits.

#### **1.07 SCHEDULING**

- A. After the award of contract, the Contractor shall prepare a detailed schedule (aka milestone chart) using "Microsoft Project" software or equivalent. The Contractor Project Schedule (CPS) shall indicate detailed activities for the projected life of the project. The CPS shall consist of detailed activities and their restraining relationships. It will also detail manpower usage throughout the project.
- B. It is the responsibility of the Contractor to coordinate all work with the other trades for scheduling, rough-in, and finishing all work specified. The owner will not be liable for any additional costs due to missed dates or poor coordination of the supplying contractor with other trades.

#### **1.08 REVIEW OF CONTRACT DRAWINGS AND EQUIPMENT DATA SUBMITTALS**

(Note: The Contractor is encouraged, but not required, to submit separate technical submittal(s) outlining alternate technical approach(s) to the system requirements stated herein as long as each alternate technical document(s) is complete, separate, and submitted in precisely the same manner as outlined herein. VA will review and rate each received alternate submittal, which follows this requirement, in exactly the same procedure as outlined herein. Partial, add-on, or addenda type alternates will not be accepted or reviewed.)

- A. Submit at one time within 10 days of contract awarding, drawings and product data on all proposed equipment and system. Check for compliance with contract documents and certify compliance with Contractor's "APPROVED" stamp and signature.
- B. Support all submittals with descriptive materials, i.e., catalog sheets, product data sheets, diagrams, and charts published by the manufacturer. These materials shall show conformance to specification and drawing requirements.
- C. Where multiple products are listed on a single cut-sheet, circle or highlight the one that you propose to use. Provide a complete and through equipment list of equipment expected to be installed in the system, with spares, as a part of the submittal. Special Communications (TVE-005OP3B) will not review any submittal that does not have this list.
- D. Provide four (4) copies to the PM for technical review. The PM will provide a copy to the offices identified in Paragraph 1.3.C & D, at a minimum for compliance review as described herein where each responsible individual(s) shall respond to the PM within 10 days of receipt of their acceptance or rejection of the submittal(s).
- E. Provide interconnection methods, conduit (where not already installed), junction boxes (J-Boxes), cable, interface fixtures and equipment lists for the: ENR(s) ( aka DMARC), TER, TCR, MCR, MCOR, PCR, ECR, Stacked Telecommunications Rooms (STR), Nurses Stations (NS), Head End Room (HER), Head End Cabinet (HEC), Head End Interface Cabinet (HEIC) and approved TCO locations Telecommunications Infrastructure Plant (TIP) interface distribution layout drawing, as they are to be installed and interconnected to each other.
- F. Headend and each interface distribution cabinet layout drawing, as they are expected to be installed.

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- G. Equipment OEM technical literature detailing the electrical and technical characteristics of each item of equipment to be furnished.
- H. Engineering drawings of the System, showing calculated of expected signal levels at the headend input and output, each input and output distribution point, and signal level at each telecommunications outlet.
- I. Surveys Required as a Part of The Technical Submittal:
  - 1. The Contractor shall provide the following System survey(s) that depict various system features and capacities required in addition to the on-site survey requirements described herein. Each survey shall be in writing and contain the following information (the formats are suggestions and may be used for the initial Technical Submittal Survey requirements), as a minimum:
    - a. PA Cable System Design Plan:
      - 1) An OEM and contractor designed functioning PA System cable plan to populate the entire TIP empty conduit/pathway distribution systems provided as a part of Specification 27 11 00 shall be provided as a part of the technical proposal. A specific functioning PA: cable, interfaces, J-boxes and back boxes shall coincide with the total growth items as described herein. It is the Contractor's responsibility to provide the Systems' entire PA cable and accessory requirements and engineer a functioning PA distribution system and equipment requirement plan of the following paragraph(s), at a minimum:
      - 2) The required PA Equipment Locations:

EQUIPPED ITEM	CAPACITY	GROWTH
Master Control Stations		
Telephone Operators Room		
Police Control Room		
Other		
Zone Amplifiers		
All Call (complete Zone 1)		
Admissions (Zone 2)		
Entrance (Zone 2a)		
Pharmacy Dispensing (Zone 2a)		
Agent Cashier (Zone 2a)		
Other (Zone 2a)		
Labs (Zone 3)		
Blood (Zone 3a)		
Dissecting (Zone 3a)		
Other (Zone 3a)		
Clinics (Zone 4)		
Dental (Zone 4a)		
Radiology (Zone 4a)		
Oncology (Zone 4a)		
Other (Zone 4a)		
Other (Zone 5a)		
Spare (Zones 6, 7 & 8)		
Other (Zone __) //		

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Supervisory Panel(s)		
Trouble Panel(s)		
Locations		
Speakers		
Overhead		
Locations		
Other		
Outside		
Locations		
Other		
Horn		
Locations		
Other		
Power Supply(s)		
Location		
Other		
UPS(s)		
Location		
Other		
Radio Paging Access (when pre-approved by TVE-005OP3B)		
Wireless Access (when pre-approved by TVE-005OP3B)		
Maintenance/Programming Console		
Location(s)		
Other		

- 3) The required PA Cable Plant/Connections:  
 The Contractor shall clearly and fully indicate this category for each item identified herein as a part of the technical submittal. For this purpose, the following definitions and sample connections are provided to detail the system's capability:

<b><u>EQUIPPED ITEM</u></b>	<b><u>CAPACITY</u></b>	<b><u>GROWTH</u></b>
Central Control Cabinet/Equipment		
Location		
Power Supply(s)		
UPS(s)		
Essential Electrical Power Panel(s)		
Other		
Cable Plant		
Supply to Locations		

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Identified herein		
Speaker Locations		
Remote Locations		
Telephone Operator Room		
Police Control Room		
Other		
Maintenance/Program Console		
Location(s)		
Other		
LAN (Local Facility) Access/Equipment/Location (when pre-approved by TVE-005OP3B)		
Wireless Access/Equipment/Location (when pre-approved by TVE-005OP3B)		
Other		

**1.09 PROJECT RECORD DOCUMENTS (AS BUILTS)**

- A. Throughout progress of the Work, maintain an accurate record of changes in Contract Documents. Upon completion of Work, transfer recorded changes to a set of Project Record Documents.
- B. The floor plans shall be marked in pen to include the following:
  - 1. All device locations with UL labels affixed.
  - 2. Conduit locations.
  - 3. Head-end equipment and specific location.
  - 4. Each interface and equipment specific location.
  - 5. Facility Entrance (aka DEMARC) Room(s) interface equipment and location(s).
  - 6. Telephone Equipment Room (TER) interface equipment and specific location.
  - 7. Main Computer Room (MCR) interface equipment and specific location.
  - 8. Police Control Room (PCR) interface equipment and specific location.
  - 9. Engineering Control Room (ECR) interface equipment and specific location
  - 10. Telecommunication Outlet (s –TCO) equipment and specific location
  - 11. TIP Wiring diagram(s).
  - 12. Warranty certificate.
  - 13. System test results.
  - 14. System Completion Document(s) or MOU.

**1.10 WARRANTIES / GUARANTY**

- A. The Contractor shall warrant the installation to be free from defect in material and workmanship for a period of two (2) years from the date of acceptance of the project by the owner. The Contractor shall agree to remedy covered defects within four (4) hours of notification of major failures or within twenty-four (24) hours of notification for individual station related problems.
- B. The Contractor shall agree to grantee the system according to the guidelines outlined in Article 4 herein.

**1.11 USE OF THE SITE**

- A. Use of the site shall be at the GC's direction.

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- B. Coordinate with the GC for lay-down areas for product storage and administration areas.
- C. Coordinate work with the GC and their sub-contractors.
- D. Access to buildings wherein the work is performed shall be directed by the GC.

**1.12 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft.
- B. Store products in original containers.
- C. Coordinate with the GC for product storage. There may be little or no storage space available on site. Plan to potentially store materials off site.
- D. Do not install damaged products. Remove damaged products from the site and replaced with new product at no cost to the Owner.

**1.13 PROJECT CLOSE-OUT**

- A. Prior to final inspection and acceptance of the work, remove all debris, rubbish, waste material, tools, construction equipment, machinery and surplus materials from the project site and thoroughly clean your work area.
- B. Before the project closeout date, the Contractor shall submit:
  - 1. Warranty certificate.
  - 2. Evidence of compliance with requirements of governing authorities such as the Low Voltage Certificate of Inspection.
  - 3. Project record documents.
  - 4. Instruction manuals and software that is a part of the system.
- C. Contractor shall submit written notice that:
  - 1. Contract Documents have been reviewed.
  - 2. Project has been inspected for compliance with contract.
  - 3. Work has been completed in accordance with the contract.

**PART 2 – PRODUCTS / FUNCTIONAL REQUIREMENTS**

**2.01 GENERAL REQUIREMENTS FOR EQUIPMENT AND MATERIALS**

- A. Furnish and install a complete and fully functional and operable Nurse Call System for each location shown on the contract drawings and TCOs WHOSE EMPTY CONDUIT SYSTEM WAS PROVIDED AS A PART OF SPECIFICATION 27 11 00.
- B. The specific location for each PA: Central Control Cabinet is // \_\_\_\_\_, // Power Supply is // \_\_\_\_\_, // Electrical Supervisor Panel is // \_\_\_\_\_, // UPS is // \_\_\_\_\_, // Two (2) Remote Annunciation Consoles is // \_\_\_\_\_, // Main Equipment Cabinet is // \_\_\_\_\_, // Speaker is // \_\_\_\_\_, // Zone is // \_\_\_\_\_, // Sub Zone is // \_\_\_\_\_, // and TCOs are // \_\_\_\_\_ (list locations here AND indicate like locations on the contract drawings) //.
- C. Coordinate features and select interface components to form an integrated PA system. Match components and interconnections between the systems for optimum performance of specified functions.
- D. Expansion Capability: The PA equipment interfaces and cables shall be able to increase number of enunciation points in the future by a minimum of 50 percent (%) above those indicated without adding any internal or external components or main trunk cable conductors.
- E. Equipment: Active electronic type shall use solid-state components, fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied between 110 to 130 VAC, 60 Hz.
- F. Meet all FCC requirements regarding low radiation and/or interference of RF signal(s). The system shall be designed to prevent direct pickup of signals from within and outside the building structure.

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- G. Weather/Water Proof Equipment: Listed and labeled by an OSHA certified National Recognized Testing Laboratory (NRTL – i.e. UL) for duty outdoors or in damp locations.
- H. Deliver a fully functioning and operable PA in the specific locations shown on the drawings.

**2.02 SYSTEM DESCRIPTION**

- A. Furnish and install a complete and fully functional and operable HF Radio System. Provide additional require conduit(s) according to Specification 27 11 00.
- B. The Contractor is responsible for interfacing the MATV // //, RED // //, Patient Bed Service Walls // //, SSC Room// // and \_\_\_\_\_ // systems with the System and shall be the interface points for connection of the radio interface cabling from the interface unit(s). The interface unit(s) shall be provided by the Contractor.
- C. The Contractor shall continually employ interfacing methods that are approved by the OEM and VA. At a minimum, an acceptable interfacing method requires not only a physical and mechanical connection, but also a matching of signal, voltage, and processing levels with regard to signal quality and impedance. The total PA system shall be configured and installed so that the combination of equipment actually employed does not produce any undesirable visual or aural effects such as signal distortions, noise pulses, glitches, hum, transients, images, etc. The interface points must adhere to all standards described herein for the full separation of Critical Care and Life Safety systems.
- D. It is not acceptable to utilize the telephone cable system for the control of radio signals and equipment. The System Contractor shall connect the Telephone System Remote Control System to the Radio System Paging Control Unit ensuring that all NFPA and UL Critical Care and Life Safety Circuit and System separation guidelines are satisfied. The System Contractor is not allowed to make any connections to the Telephone System. The Owner shall arrange for the interconnection between the PA and Telephone Systems with the appropriate responsible parties.
- E. System hardware shall consist of a standalone (separate) PA communications network comprised of amplifiers, mixers, speakers, volume controls, test sets, telephone private branch exchange (PBX) interface equipment, equipment cabinets/racks, wiring and other options such as, sub zoning in addition to “all call” functions, computer interfaces, printer interfaces and wireless network interfaces, (when specifically approved by 005OP3B and VA Headquarters Spectrum Management 005OP2B – herein after referred to as 005OP2B) as shown on drawings. All necessary equipment required to meet the intent of these specifications, whether or not enumerated within these specifications, shall be supplied and installed to provide a complete and operating nurse/patient communications network.
- F. Systems firmware shall be the product of a reputable firmware OEM of record with a proven history of product reliability and sole control over all source code. Manufacturer shall provide, free of charge, product firmware/software upgrades for a period of two (2) years from date of acceptance by VA for any product feature enhancements. System configuration programming changes shall not require any exchange of parts and shall be capable of being executed remotely via a modem connection (when specifically approved first by 005OP3B).
- G. The PA Head End Equipment shall be located in Telecommunications //PBX/Telephone Room //\_\_\_\_\_. The PA shall cover floor(s) //\_\_\_\_\_/ and areas //\_\_\_\_\_, //\_\_\_\_\_, and //\_\_\_\_\_. The PA shall provide zoned, one-way voice paging through distributed, ceiling mounted loudspeakers. Voice input into the PA shall be by zone using the telephone system. The Nurse Call / Code Blue System may interface the PA system when specifically approved by VA Headquarters 005OP3B during the project approval process prior to contract bidding.
- H. The System shall utilize microprocessor components for all signaling and programming circuits and functions. Self-contained or on board system program memory shall be non-volatile and protected from erasure from power outages for a minimum of 24 hours.

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- I. Provide a backup battery or a UPS for the System (including each distribution cabinet/point, CRT, LCD and Monitor) to allow normal operation and function (as if there was no AC power failure) in the event of an AC power failure or during input power fluctuations for a minimum of two (2) Hours.
- J. The System is defined as Emergency Service and the Code Blue functions is defined as Life Safety/Support by NFPA (re Part 1.1.A) and so evaluated by JCAHCO. Therefore, the system shall have a minimum of two (2) additional remote enunciation points in order to satisfy NFPA's Life Safety Code 101 where each enunciation point shall fully function independent of the Facility's PBX.
  1. These two (2) additional remote locations shall be fully manned:
    - a. 24/7/365 for certified Hospital //Clinics// // other \_\_\_\_\_//.
    - b. As long as other identified VA Medical / Servicing Facilities are open for servicing patients.
    - c. The minimum remote enunciation locations shall be:
      - 1) The Telephone / PBX Operator Room.
      - 2) The Police Control / Operations Room.
      - 3) Other location(s) that is specifically approved by VA Headquarters TVE - 005OP3B DURING THE PROJECT DEVELOPMENT STAGES AND PRIOR TO EQUIPMENT PURCHASE.
    - d. One (1) global (aka "all call") hard wired zone shall be provided that connects to every system speaker.
    - e. There shall be //\_\_\_\_\_// hard-wired sub-zones designated as follows:
      - 1) Department A.
      - 2) Department B.
      - 3) Department C.
      - 4) Department D.
      - 5) Department E.
      - 6) Each //\_\_\_\_\_// zone shall be capable of be programmed.
      - 7) The System shall have a minimum of three (3), unused zones.
  2. The System shall allow voice pages to be made within a single zone, across programmed multiple zones or a global page (all zones) by using preset codes entered into the keypad of any telephone instrument attached to the PBX.
- K. The System shall interface with the Facility's existing PAS so that a global page (aka "all call" page) is communicated to the existing PAS and the new System of this project. Arrangements for interconnection of the System and the telephone system(s) shall be coordinated with the owner and the PBX provider.
- L. The system shall be designed to provide continuous electrical supervision of the complete and entire system (i.e. light bulbs, wires, contact switch connections, master control stations, wall stations, circuit boards, data, audio, and communication busses, main and UPS power, etc.). All alarm initiating and signaling circuits shall be supervised for open circuits, short circuits, and system grounds. Main and UPS power circuits shall be supervised for a change in state (i.e. primary to backup, low battery, UPS on line, etc.). When an open, short or ground occurs in any system circuit, an audible and visual fault alarm signal shall be initiated at the main supervisory panel, nurse control station and all remote amplifier locations.
- M. When the System is approved to connect to a separate communications system (i.e. LAN, WAN, Telephone, Nurse Call, radio raging, wireless systems, etc.) the connection point shall be at one location and shall meet the following minimum requirements for each hard wired connection (note each wireless system connection MUST BE APPROVED PRIOR TO CONTRACT BID BY VA HEADQUARTERS 005OP3B AND 005OP2B):
  1. UL 60950-1/2.
  2. FIPS 142.
  3. FCC Part 15 Listed Radio Equipment is not allowed.



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- N. All passive distribution equipment shall meet or exceed -80 dB radiation shielding (aka RFI) shielding specifications and be provided with screw type audio connectors.
- O. All equipment face plates utilized in the system shall be stainless steel, anodized aluminum or UL approved cycolac plastic for the areas where provided.
- P. All trunk, branch, and interconnecting cables and unused equipment ports or taps shall be terminated with proper terminating resistors designed for RF, audio and digital cable systems without adapters.
- Q. Noise filters and surge protectors shall be provided for each equipment interface cabinet, headend cabinet, control console and local and remote amplifier locations to insure protection from input primary AC power surges and to insure noise glitches are not induced into low voltage data circuits.
- R. Plug-in connectors shall be provided to connect all equipment, except coaxial cables and RF transmission line interface points. Coaxial cable distribution points and RF transmission lines shall use coaxial cable connections recommended by the cable OEM and approved by the system OEM. Base band cable systems shall utilize barrier terminal screw type connectors, at a minimum. As an alternate, crimp type connectors installed with a ratchet type installation tool are acceptable provided the cable dress, pairs, shielding, grounding, connections and labeling are the same as the barrier terminal strip connectors. Tape of any type, wire nuts or solder type connections are unacceptable and will not be approved.
- S. Audio Level Processing: The control equipment shall consist of audio mixer(s), volume limiter(s) and/or compressor(s), and power amplifier(s) to process, adjust, equalize, isolate, filter, and amplify each audio channel for each sub-zone in the system and distribute them into the System's RF interfacing distribution trunks and amplification circuits. It is acceptable to use identified Telephone System cable pairs designated for Two-Way Radio interface and control use or identified as spare telephone cable pairs by the Facility's Telephone System Contractor. The use of telephone cable to distribute RF signals, carrying system or sub-system AC or DC voltage is not acceptable and will not be approved. Additionally, each control location shall be provided with the equipment required to insure the system can produce its designed audio channel capacity at each speaker identified on the contract drawings. The Contractor shall provide: a spare set of telephone paging modules as recommended by the OEM (as a minimum provide one spare module for each installed module); one spare audio power amplifier, one spare audio mixer, one spare audio volume limiter and/or compressor, and one spare audio automatic gain adjusting device, and minimum RF equipment recommended by the OEM.
- T. Contractor is responsible for pricing all accessories and miscellaneous equipment required to form a complete and operating system. Unless otherwise noted in this Part, equipment quantities shall be as indicated on the drawings.

**2.03 SYSTEM PERFORMANCE:**

- A. At a minimum, each distribution, interconnection, interface, terminating point and TCO shall be capable of supporting the Facility's PA system voice and data service as follows:
  - 1. Shall be compliant with and not degrade the operating parameters of the Public Switched Telephone Network (PSTN) and the Federal Telecommunications System (FTS) at each PSTN and FTS interface, interconnection and terminating locations in the TERs.
  - 2. Audio Input: The signal level of each audio input channel at each input point shall be a MINIMUM of zero decibels measured (dBm), +0.10 dBm across 150 Ohms, balanced.
  - 3. Audio Output: The audio signal level at each speaker shall be a MINIMUM of +0.25 Watt (W) and a maximum of +20 W, 600 Ohms balanced impedance, on a 70.7 V audio distribution line Contractor to determine and set each speaker's proper audio signal level (top) based on speaker location and the ambient noise level in speaker coverage area.
  - 4. The system shall meet the following MINIMUM parameters at each speaker:
    - a. Cross Modulation: -46 dB
    - b. Hum Modulation: -55 dB

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- c. Isolation (outlet-outlet): 24 dB
  - d. Impedance:
    - 1) Distribution: 600 Ohm balanced @ 70.7 V audio line level.
    - 2) Speaker: Selectable, as required.
  - e. Audio Gain: 10 dB minimum @ mid-range measured with a sound pressure level meter (SPL)
  - f. Signal to noise (S/N) ratio: 35 dB, minimum
- B. Audio Level Processing: The head-end equipment shall consist of audio mixer(s), volume limiter(s) and/or compressor(s), and power amplifier(s) to process, adjust, equalize, isolate, filter, and amplify each audio channel for each zone or sub-zone in the system and distribute them into the system's distribution trunks. It is acceptable to use identified telephone system cable pairs designated for PA use or identified as spare telephone cable pairs by the Facility's Telephone System Contractor.
- 1. THE USE OF TELEPHONE CABLE TO DISTRIBUTE PA SIGNALS CARRYING AC OR DC VOLTAGE IS NOT ACCEPTABLE AND WILL NOT BE APPROVED.
  - 2. Additionally, each remote location shall be provided with the equipment required to ensure the system supervision and designed audio channel capacity at each speaker identified on the contract drawings.

#### 2.04 MANUFACTURERS

- A. The products specified shall be new, FCC and UL Listed, labeled and produced by OEM of record. An OEM of record shall be defined as a company whose main occupation is the manufacture for sale of the items of equipment supplied and which:
  - 1. Maintains a stock of replacement parts for the item submitted,
  - 2. Maintains engineering drawings, specifications, and operating manuals for the items submitted, and
  - 3. Has published and distributed descriptive literature and equipment specifications on the items of equipment submitted at least 30 days prior to the Invitation for Bid (IFB).
- B. Specifications contained herein as set forth in this document detail the salient operating and performance characteristics of equipment in order for VA to distinguish acceptable items of equipment from unacceptable items of equipment. When an item of equipment is offered or furnished for which there is a specification contained herein, the item of equipment offered or furnished shall meet or exceed the specification for that item of equipment.
- C. Equipment Standards and Testing:
  - 1. The System has been defined herein as connected to systems identified as an Emergency performing Public Safety Support Functions. Therefore, at a minimum, the system shall conform to all aforementioned National and/or Local Public and Life Safety Codes (which ever are the more stringent), NFPA, NEC, this specification, JCAHCO Life Safety Accreditation requirements, and the OEM recommendations, instructions, and guidelines.
  - 2. All supplies and materials shall be listed, labeled or certified by UL or a nationally recognized testing laboratory (NRTL) where such standards have been established for the supplies, materials or equipment.
  - 3. The provided equipment required by the System design and approved technical submittal must conform with each UL standard in effect for the equipment, as of the date of the technical submittal (or the date when the RE approved system equipment necessary to be replaced) was technically reviewed and approved by VA. Where a UL standard is in existence for equipment to be used in completion of this contract, the equipment must bear the approved UL seal.
  - 4. Each item of electronic equipment to be provided under this contract must bear the approved UL seal or the seal of the testing laboratory that warrants the equipment has been tested in accordance with, and conforms to the specified standards. The placement of the UL Seal shall be a permanent part of the electronic equipment that is not capable of being transportable from one equipment item to another.

## 2.05 PRODUCTS

### A. General.

1. Contractor is responsible for pricing all accessories and miscellaneous equipment required to form a complete and operating system. The equipment quantities provided herein shall be as indicated on the drawings with the exception of the indicated spare equipment.
2. Each cabinet shall be provided with internal and external items to maintain a neat and orderly system of equipment, wire, cable and conduit connections and routing.
3. Contractor Furnished Equipment List (CFEs):
  - a. The Contractor is required to provide a list of the CFE equipment to be furnished. The quantity, make and model number of each item is required. Select the required equipment items quantities that will satisfy the needs of the system as described herein and with the OEM's concurrence applied to the list(s), in writing.

### B. ENT (aka DEMARC) Room(s):

Refer to CFM Physical Security Manual (07-2007) for VA Facilities, Chapters 9.3 & 1) and PG 18-10, EDM, Chapters 7- Table 7-1, 8 & Appendix B, Telecommunications One Line Topology for specific Room and TIP Connection Requirements.

### C. TER, TCR, TR, SCC, PCR, STR, HER Rooms and Equipment:

### D. Refer to CFM Physical Security Manual (07-2007) for VA Facilities, Chapters 9.3 & 1) and PG 18-10, EDM, Chapters 7- Table 7-1, 8 & Appendix B, Telecommunications One Line Topology for specific Room and TIP Connection Requirements.

#### 1. Interface Equipment:

##### a. TER:

##### 1) Paging adaptor:

- (a) The Contractor shall coordinate the installation of the paging adapter(s) designed for use with the Facility's telephone system with the Facility Telephone Contractor or local telephone company.
- (b) The Contractor shall provide and install a paging adapter(s) for each zone and sub zone. The paging adapter(s) shall be accessible by dialing a telephone number provided by the Facility's Telephone Contractor. The Paging Adapter shall:
  - (1) Monitor each audio input and output on the unit.
  - (2) Be provided with an electrical supervision panel to provide both audio and visual trouble alarms.
  - (3) Be provided as part of the head end equipment and shall be located in the Telephone Switch Room
  - (4) Be provided with Executive (aka emergency) Paging Override of all routine paging calls in progress or being accessed to allow system "all call" (aka global) and radio paging calls designated as (Code One Blue) functions.
  - (5) Be capable of internal time out capability.
  - (6) Function completely with the interface module.
  - (7) Provide one spare adapter.
- (c) Time Out Device: A time out device/capability shall be provided to prevent system "hang-up" due to an off-hook telephone. The device shall be able to be preset from 30 seconds to two (2) minutes. Its function shall not interfere with or override the required "all call" (aka global) operational capability.
  - (1) Central Processor Module:
  - (2) Controls system operations and holds all programmed parameters.
  - (3) Data link connection to additional CPU modules.

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- (d) Power Module: Provides 12V DC @ 800mA to Central Processor Module.
- (e) Minimum three (3) Zone Module:
  - (1) Provides a minimum of three (3) paging zone outputs at 70V audio sound level.
  - (2) Background Music inhibit switch for each zone.
- 2. Audio Monitor Panel:
  - a. The panel shall be EIA/TIA standard for 483 mm (19") cabinet mounting.
  - b. It shall be provided in the upper portion of the head-end equipment cabinet.
  - c. Provide one (1) spare panel.
- 3. Trouble Annunciator Panel:
  - a. A trouble annunciator panel shall be provided in the head-end cabinet, and at locations as designated on the contract drawings. The panel(s) shall be compatible with or generate electrical and/or electronic supervising signals to continuously monitor the operating condition for the System head-end audio power amplifier(s), remote power amplifier(s), microphone consoles and interconnecting trunks. The panels shall generate an audible and visual signal when the System's supervising system detects an amplifier or trunk-line is malfunctioning.
  - b. Provide one (1) spare panel.
- 4. Head-End Equipment
  - a. Provide all required power supplies, communications hubs, network switches, intelligent controllers and other devices necessary to form a complete system listed herein. Head-end components may be rack mounted or wall mounted in a metal enclosure.
  - b. Provide the head end equipment in the closed telecommunications closet where the PA system is installed to include the minimum equipment listed herein.
  - c. Provide minimum of 30 minute battery back-up to system components.
- 5. Equipment Cabinet: Comply with TIA/EIA-310-D. Lockable, ventilated metal cabinet houses terminal strips, power supplies, amplifiers, system volume control, and other switching and control devices required for conversation channels and control functions
  - a. Vertical Equipment Rack, Wall Mounted (to be included inside of the Equipment Cabinet):
  - b. 74" (48RU) rack space, Welded Steel construction, Minimum 20" usable depth, Adjustable front mounting rails.
    - 1) Install the following products in rack provided by same manufacturer or as specified:
    - 2) Security screws w/ nylon isolation bushings.
    - 3) Textured blank panels.
    - 4) Custom mounts for components without rack mount kits.
    - 5) Security covers.
    - 6) Copper Bus Bar.
    - 7) Power Sequencer rack mounted power conditioner and (provide as needed) delayed sequencer(s) with two (2) in switched outlets each and contact closure control inputs.
    - 8) Rack mounting: Provide rack mount kit.
- 6. Amplifier Equipment:
  - a. Paging (aka zone):
    - 1) Inputs for 600-ohm balanced telephone line, LO-Z balanced microphone, and background music.
    - 2) Input Sensitivity: Compatible with master stations and central equipment so amplifier delivers full rated output with sound-pressure level of less than 10 dynes/sq. cm impinging on master stations speaker microphones, or handset transmitters

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- 3) Automatic Level Control (ALC) for pages, adjustable background music muting level during page, wall or rack mountable.
- 4) 16-ohm, 25V, 25V center tapped (CT), and 70V outputs. Amplifier quantity and size (output power) as needed. Continuous amplifier power rating shall exceed loudspeaker load on amplifier by at least 25%.
- 5) Output Power: 70-V balanced line. 80 percent of the sum of wattage settings of connected for each station and speaker connected in all-call mode of operation, plus an allowance for future stations.
- 6) Total Harmonic Distortion: Less than 5 percent at rated output power with load equivalent to quantity of stations connected in all-call mode of operation.
- 7) Minimum Signal-to-Noise Ratio: 45 dB, at rated output.
- 8) Frequency Response: Within plus or minus 3 dB from 70 to 12,000 Hz.
- b. Output Regulation: Maintains output level within 2 dB from full to no load.
- c. Amplifier Protection: Prevents damage from shorted or open output.
- d. Be provided with electronic supervision function(s).
- e. Provide one spare amplifier.
7. Wireless (when specifically approved by TVE 005OP3B):
  - a. Radio Paging Equipment / Systems:
    - 1) The PA system shall have the ability to interface only with VA certified and licensed radio paging system (FCC Part 15 listed pagers and transmitters are not allowed for "Safety of Life" functions or installed in those specific areas – VA Headquarters TVE – 0050PB2 and SM – 0050PB2 are the only approving authorities for this function)and must have the following minimum system features:
      - (a) Ability to pass-through location information (such as a room number) and call-type as well as other text messages simultaneously to shift supervisor identified staff members.
      - (b) System shall allow the operator to select staff members by name and pager number and to select a message consisting of a room number and a condition code (aka priority level). Operator may also choose to type in a unique alpha-numeric text message (the text message shall meet or exceed all HIPA and VAOCIP Communications Security Guidelines for the transmission of Patient or Staff Specific information[aka PII] – VA Headquarters TVE – 0050P2B is the approving authority for this function) into the system to be read by the holder of the pager unit.
      - (c) While a patient station is connected to the nurse's master station, the system shall allow the operator to automatically page the staff member assigned to the room. An alternate staff member maybe selected for paging purposes in place of the primary staff member. The system must allow an alternate staff member to be paged when the primary staff member is unable to respond to patient's needs within a specified period of time. The System must have the ability to assign any bed to any pager or pager group, and to assign an unlimited amount of pagers to any patient bed.
      - (d) System shall have the ability to send all code blue calls to staff members by predetermined group (as required) automatically by simply pressing one "Code Blue" button. Pager shall indicate room number of code call, and state "Code Blue" in plain English format on pagers (FCC Part 15 listed pagers are not allowed to be used as "Safety of Life" functions or those specific locations – VA Headquarters TVE –0050P2B is the approving authority for this requirement)
      - (e) Personal Wireless Communicator: The PA system will only be allowed to connect to the personal wireless communications system, pass text data and provide a 2-way communication between the Telephone Interface and the personal wireless communicator as long as it is not a FCC Part 15 listed

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device(s), meets or exceeds UL 60950-1/2, meets OCIS Guide Lines for FIPS 140-2 certification and the using staff shows an extensive training program along with recertification(s) according to the Facility Emergency Plan concerning HIPA requirements.//

- (f) Other Wireless Equipment / Systems: Each proposed wireless system and/or equipment to be connected to or be a part of the system, each shall meet the minimum requirements outlined herein.//
- b. TCR:
  - 1) Microphone Paging Console:
    - (a) A console shall be provided in the TCR and PCR's as shown on the drawings.
    - (b) The console shall contain visual enunciators for each connection to the telephone system's Public Address Paging Adapter. The visual enunciators shall display all the System connections to the telephone system being used.
    - (c) The console shall be fully independent of the Facility's telephone system so if the telephone system has a catastrophic failure (aka partial, multiple or total system failure) the microphone console will function normally as if the Facility's telephone system was operating normally. The restoration of the Facility's telephone system shall not affect the System.
    - (d) Each microphone console shall:
      - (1) Be Mounted: Flush unless otherwise indicated, and suitable for mounting conditions indicated.
      - (2) Have a Faceplate: Stainless steel or anodized aluminum with tamperproof mounting screws.
      - (3) Have a system interface Back Box: Minimum Two-gang galvanized steel with 2-1/2 inch minimum depth.
      - (4) Have an Internal Speaker: 3 inches, 2.3 oz. minimum; permanent magnet.
      - (5) Have a Call Switch: Mount on faceplate. Permits calls to The system.
      - (6) When approved - in lieu of a standalone microphone, provide a Handset with Hook Switch: Have a Handset with Hook Switch: Telephone type with 24-inch-long, permanently coiled cord. Arrange to disconnect speaker when handset is lifted.
      - (7) Be provided with an electrical supervision panel to provide both audio and visual trouble alarms to the Nurse Call /Code Blue electrical supervision system.
      - (8) Be capable of internal time out capability.
      - (9) Be completely compatible with the Telephone Interface unit(s)
  - 2) Electrical Supervision Trouble Annunciator Panel:
    - (a) The Electrical Supervision Trouble Annunciation Panel shall be located in the TCR and PCR's SCC.
    - (b) The panel(s) shall be compatible with the generated electrical and/or electronic supervising signals to continuously monitor the operating condition for the PA system head-end processing equipment, local/remote control consoles, audio power amplifier(s), UPS, power supplies, dome lights and interconnecting trunks. The panels shall generate an audible and visual signal when the System's supervising system detects a system trouble or trunk-line is malfunctioning.
    - (c) TRs: Locate the PA floor distribution equipment within each TR as required by system design and OEM direction. Provide secured and lockable cabinet/rack(s) as required.
      - (1) General Equipment: Provide all required power supplies, communications hubs, network switches, intelligent controllers and

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other devices necessary to form a complete system listed herein.  
Equipment components may be rack mounted or wall mounted in a  
metal enclosure.

- 3) Amplifiers:
    - (a) Panging Amplifier Equipment:
    - (b) Refer to the Amplifier characteristics described herein Paragraph 2.4.G.f.
    - (c) Provide one (1) spare amplifier in addition to the spare Head End Amplifier.
  - 4) Distributed Amplifier:
    - (a) Provide the type and number of the amplifier(S) required to meet the system design. Provide this unit as complete and separate technical submittal during the IFB review portion of the project.
    - (b) Provide one spare amplifier for each 20% (or portion thereof) of amplifiers used in the system.
  - 5) Provide the equipment in the nearest TER where the System is installed to include the minimum equipment listed herein.
  - 6) Provide minimum of 30 minute battery (UPS) back-up to system components.
  - 7) Equipment Cabinet: Comply with cabinet requirements as aforementioned.
  - 8) Trouble Annunciator Panel: Comply with the panel characteristics identified herein.
- c. SCC, PCR, STR, HER: Refer to PG-18-10, Article 7 for specific required equipment and use minimum aforementioned specifications for population.

E. TIP DISTRIBUTION SYSTEM:

1. System Speakers:

a. Ceiling Cone-Type:

- 1) Minimum Axial Sensitivity: 91 dB at one meter, with 1-W input.
- 2) Frequency Response: Within plus or minus 3 dB from 70 to 15,000 Hz.
- 3) Minimum Dispersion Angle: 100 degrees.
- 4) Line Transformer: Maximum insertion loss of 0.5 dB, power rating equal to speaker's, and at least four level taps.
- 5) Enclosures: Steel housings or back boxes, acoustically dampened, with front face of at least 0.0478-inch steel and whole assembly rust proofed and factory primed; complete with mounting assembly and suitable for surface ceiling, flush ceiling, pendant or wall mounting; with relief of back pressure.
- 6) Baffle: For flush speakers, minimum thickness of 0.032-inch aluminum with textured white finish. Completely fill the baffle with fiberglass.
- 7) Vandal-Proof, High-Strength Baffle: For flush-mounted speakers, self-aging cast aluminum with tensile strength of 44,000 psi, 0.025-inch minimum thickness; countersunk heat-treated alloy mounting screws; and textured white epoxy finish.
- 8) Size: 8 inches with 1-inch voice coil and minimum 5-oz. ceramic magnet.
- 9) Have a minimum of two (2) safety wires installed to a solid surface or use a flexible conduit from ceiling / wall back box to the speaker back box.
- 10) The speakers and mounting shall be self-contained and wall mounted with flush back box at a minimum of 10 meter intervals and shall match (or contrast with, at the direction of the RE) the color of the adjacent surfaces.
- 11) Provide one spare speaker, mount, and back box for each 50 speakers or portion thereof.

b. Wall Mounted Horne-Type:

- 1) Each horn speaker shall be provided with a means of adjusting the output level over the rated horn speaker range to an appropriate audio level in the area installed.
- 2) Provide horn speakers in equipment rooms, mechanical room, supply warehouse areas, loading dock, entrance and exit areas, and at other areas as

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- indicated on the drawings.
- 3) Speakers shall be all-metal, weatherproof construction; complete with universal mounting brackets.
  - 4) Frequency Response: Within plus or minus 3 dB from 275 to 14,000 Hz.
  - 5) Minimum Power Rating of Driver: 15 W, continuous.
  - 6) Minimum Dispersion Angle: 110 degrees.
  - 7) Line Transformer: Maximum insertion loss of 0.5 dB, power rating equal to speaker's, and at least four level taps.
  - 8) Provide one spare speaker, mount, and back box for each 20 speakers or portion thereof.
- c. System Cables: In addition to the TIP provided under Specification Section 27 15 00 – TIP Horizontal and Vertical Communications Cabling, provide the following additional TIP installation and testing requirements, provide the following minimum System TIP cables & interconnections:
- 1) Line Level Audio and Microphone Cable:
    - (a) Line level audio and microphone cable for inside racks and conduit.
    - (b) Shielded, twisted pair Minimum 22 American Wire Gauge (AWG), stranded conductors and 24 AWG drain wire with overall jacket.
  - 2) Speaker Level (Audio 70.7Volt [V]) Cable, Riser Rated:
    - (a) For use with 70.7 V audio speaker circuits.
    - (b) 18 AWG stranded pair, minimum.
    - (c) UL-1333 listed.
  - 3) Speaker Level Audio Cable, Plenum Rated (70.7V):
    - (a) For use with 70.7 V audio speaker circuits.
    - (b) 18 AWG stranded pair, minimum.
  - 4) All cabling shall be riser plenum rated.
  - 5) Provide one (1) spare 1,000 foot roll of approved System (not microphone) cable only.
2. Raceways, Back Boxes and conduit:
- a. Raceways:
    - 1) In addition to the Raceways, Equipment Room Fittings provided under Specification Sections 27 15 00 TIP Communication Room Fittings and 27 15 00 – TIP Communications Horizontal and Vertical Cabling, provide the following additional TIP raceway and fittings:
    - 2) Each raceway that is open top, shall be: UL certified for telecommunications systems, partitioned with metal partitions in order to comply with NEC Parts 517 & 800 to “mechanically separate telecommunications systems of different service, protect the installed cables from falling out when vertically mounted and allow junction boxes to be attached to the side to interface “drop” type conduit cable feeds.
    - 3) Intercommunication System cable infrastructure: EMT above accessible ceilings, 24 inches on center.
    - 4) Junction boxes shall be not less than 2-1/2 inches deep and 6 inches wide by 6 inches long.
    - 5) Flexible metal conduit is prohibited unless specifically approved by 005OP3B.
  - b. System Conduit:
    - 1) The PA system is NFPA listed as Emergency / Public Safety Communication System which requires the entire system to be installed in a separate conduit system.
    - 2) The use of centralized mechanically partitioned wireways may be used to augment main distribution conduit on a case by case basis when specifically approved by VA Headquarters (005OP3B).
    - 3) Conduit Sleeves:



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- (a) The AE has made a good effort to identify where conduit sleeves through full-height and fire rated walls on the drawings, and has instructed the electrician to provide the sleeves as shown on the drawings.
    - (b) While the sleeves shown on the drawings will be provided by others, the contractor is responsible for installing conduit sleeves and fire-proofing where necessary. It is often the case, that due to field conditions, the nurse-call cable may have to be installed through an alternate route. Any conduit sleeves required due to field conditions or those omitted by the engineer shall be provided by the cabling contractor.
  3. Device Back Boxes:
    - a. Furnish to the electrical contractor all back boxes required for the PA system devices.
    - b. The electrical contractor shall install the back boxes as well as the system conduit. Coordinate the delivery of the back boxes with the construction schedule.
  4. Telecommunication Outlets (TCO): Populate each TCO that is required to perform system operations in the locations that were provided and cabled as a part of Specifications Sections 27 11 00 and 27 15 00. Provide additional TCO equipment, interfaces and connections as required by System design. Provide secured pathway(s) and TCOs as required.
  5. UPS:
    - a. Provide a backup battery or a UPS for the System to allow normal operation and function (as if there was no AC power failure) in the event of an AC power failure or during input power fluctuations for a minimum of four (4) hours.
    - b. As an alternate solution, the telephone system UPS may be utilized to meet this requirement at the headend location, as long as this function is specifically approved by the Telephone Contractor and the RE.
    - c. The PA Contractor shall not make any attachments or connection to the telephone system until specifically directed to do so, in writing, by the RE.
    - d. Provide UPS for all active system components including but not limited to:
      - 1) System Amplifiers.
      - 2) Microphone Consoles.
      - 3) Telephone Interface Units.
      - 4) TER, TR & Headend Equipment Rack(s).
- F. Patient Bedside Prefabricated Units (PBPU):
  1. Where PBPU's exist in the Facility; the Contractor shall identify the "gang box" location on the PBPU designated for installation of the telephone jack. This location shall hereinafter be identified as the unit's TCO. The Contractor shall be responsible for obtaining written approval and specific instructions from the PBPU OEM regarding the necessary disassembly and reassembly of each PBPU to the extent necessary to pull wire from above the TIP ceiling junction box to the PBPU's reserved gang box for the unit's TCO. A Contractor provided stainless steel cover plate approved for use by the PBPU OEM and Facility IRM Chief shall finish out the jack installation.
  2. Under no circumstances shall the Contractor proceed with the PBPU installations without the written approval of the PBPU OEM and the specific instructions regarding the attachment to or modifying of the PBPU. The RE shall be available to assist the Contractor in obtaining approvals and instructions in a timely manner as related to the project's time constraints.
  3. It is the responsibility of the Contractor to maintain the UL integrity of each PBPU. If the Contractor violates that integrity, it shall be the responsibility of the Contractor to obtain on site UL re-certification of the violated PBPU at the direction of the RE and at the Contractor's expense.
- G. Installation Kit:
  1. General: The kit shall be provided that, at a minimum, includes all connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks or wire wrap

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terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, conduit, cable duct, and/or cable tray, etc., required to accomplish a neat and secure installation. All wires shall terminate in a spade lug and barrier strip, wire wrap terminal or punch block. Unfinished or unlabeled wire connections shall not be allowed. Turn over to the RE all unused and partially opened installation kit boxes, coaxial, fiberoptic, and twisted pair cable reels, conduit, cable tray, and/or cable duct bundles, wire rolls, physical installation hardware. The following are the minimum required installation sub-kits:

2. System Grounding:
  - a. The grounding kit shall include all cable and installation hardware required. All radio equipment shall be connected to earth ground via internal building wiring, according to the NEC.
  - b. This includes, but is not limited to:
    - 1) Coaxial Cable Shields.
    - 2) Control Cable Shields.
    - 3) Data Cable Shields.
    - 4) Equipment Racks.
    - 5) Equipment Cabinets.
    - 6) Conduits.
    - 7) Duct.
    - 8) Cable Trays.
    - 9) Power Panels.
    - 10) Connector Panels.
    - 11) Grounding Blocks.
3. Coaxial Cable: The coaxial cable kit shall include all coaxial connectors, cable tying straps, heat shrink tabbing, hangers, clamps, etc., required to accomplish a neat and secure installation.
4. Wire and Cable: The wire and cable kit shall include all connectors and terminals, audio spade lugs, barrier straps, punch blocks, wire wrap strips, heat shrink tubing, tie wraps, solder, hangers, clamps, labels etc., required to accomplish a neat and orderly installation.
5. Conduit, Cable Duct, and Cable Tray: The kit shall include all conduit, duct, trays, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat and secure conduit, cable duct, and/or cable tray installation in accordance with the NEC and this document.
6. Equipment Interface: The equipment kit shall include any item or quantity of equipment, cable, mounting hardware and materials needed to interface the systems with the identified sub-system(s) according to the OEM requirements and this document.
7. Labels: The labeling kit shall include any item or quantity of labels, tools, stencils, and materials needed to completely and correctly label each subsystem according to the OEM requirements, as-installed drawings, and this document.
8. Documentation: The documentation kit shall include any item or quantity of items, computer discs, as installed drawings, equipment, maintenance, and operation manuals, and OEM materials needed to completely and correctly provide the system documentation as required by this document and explained herein.

### **PART 3 - EXECUTION**

#### **3.01 PROJECT MANAGEMENT**

- A. Assign a single project manager to this project who will serve as the point of contact for the Owner, the General Contractor, and the Engineer.
- B. The Contractor shall be proactive in scheduling work at the hospital, specifically the Contractor will initiate and maintain discussion with the general contractor regarding the schedule for ceiling cover up and install cables to meet that schedule.
- C. Contact the Office of Telecommunications, Special Communications Team (005OP3B) at (301) 734-0350 to have a VA Certified Telecommunications COTR assigned to the project for

telecommunications review, equipment and system approval and co-ordination with VA's Spectrum Management and OCIS Teams.

### **3.02 COORDINATION WITH OTHER TRADES**

- A. Coordinate with the cabling contractor the location of the PA system faceplate and the faceplate opening for the PA system back boxes.
- B. Coordinate with the cabling contractor the location of TIP equipment in the TER, TCR, PA, PCR, SCC, ECR, STRs, NSs, HER and TCOs in order to connect to the TIP cable network that was installed as a part of Section Specification 27 11 00. Contact the RE immediately, in writing, if additional location(s) are discovered to be activated that was not previously provided.
- C. Before beginning work, verify the location, quantity, size and access for the following:
  - 1. Isolated ground AC power circuits provided for systems.
  - 2. Junction boxes, wall boxes, wire troughs, conduit stubs and other related infrastructure for the systems.
  - 3. System components installed by others.
  - 4. Overhead supports and rigging hardware installed by others.
- D. Immediately notify the Owner, GC and Consultant(s) in writing of any discrepancies

### **3.03 NEEDS ASSESSMENT**

- A. Provide a one-on-one meeting with the particular manager of each unit affected by the installation of the new PA system. Review the floor plan drawing, educate the nursing manager with the functions of the equipment that is being provided and gather details specific to the individual units; coverage and priorities of calls; staffing patterns; and other pertinent details that will affect system programming and training.

### **3.04 INSTALLATION**

- A. General
  - 1. Execute work in accordance with National, State and local codes, regulations and ordinances.
  - 2. Install work neatly, plumb and square and in a manner consistent with standard industry practice. Carefully protect work from dust, paint and moisture as dictated by site conditions. The Contractor will be fully responsible for protection of his work during the construction phase up until final acceptance by the Owner.
  - 3. Install equipment according to OEM's recommendations. Provide any hardware, adaptors, brackets, rack mount kits or other accessories recommended by OEM for correct assembly and installation.
  - 4. Secure equipment firmly in place, including receptacles, speakers, equipment racks, system cables, etc.
    - a. All supports, mounts, fasteners, attachments and attachment points shall support their loads with a safety factor of at least 5:1.
    - b. Do not impose the weight of equipment or fixtures on supports provided for other trades or systems.
    - c. Any suspended equipment or associated hardware must be certified by the OEM for overhead suspension.
    - d. The Contractor is responsible for means and methods in the design, fabrication, installation and certification of any supports, mounts, fasteners and attachments.
  - 5. Locate overhead ceiling-mounted loudspeakers as shown on drawings, with minor changes not to exceed 12" in any direction.
    - a. Mount transformers securely to speaker brackets or enclosures using screws. Adjust torsion springs as needed to securely support speaker assembly.
    - b. Speaker back boxes shall be completely filled with fiberglass insulation.
    - c. Seal cone speakers to their enclosures to prevent air passing from one side of the speaker to the other.

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6. Finishes for any exposed work such as plates, racks, panels, speakers, etc. shall be approved by the Architect, Owner and 005OP3B.
  7. Coordinate cover plates with field conditions. Size and install cover plates as necessary to hide joints between back boxes and surrounding wall. Where cover plates are not fitted with connectors, provide grommets in size and quantity required. Do not allow cable to leave or enter boxes without cover plates installed.
  8. Active electronic component equipment shall consist of solid state components, be rated for continuous duty service, comply with the requirements of FCC standards for telephone and data equipment, systems, and service.
  9. Color code all distribution wiring to conform to the PA Industry Standard, EIA/TIA, and this document, whichever is the more stringent. At a minimum, all equipment, cable duct and/or conduit, enclosures, wiring, terminals, and cables shall be clearly and permanently labeled according to and using the provided record drawings, to facilitate installation and maintenance.
  10. Connect the System's primary input AC power to the Facility' Critical Branch of the Emergency AC power distribution system as shown on the plans or if not shown on the plans consult with RE regarding a suitable circuit location prior to bidding.
  11. Product Delivery, Storage and Handling:
    - a. Delivery: Deliver materials to the job site in OEM's original unopened containers, clearly labeled with the OEM's name and equipment catalog numbers, model and serial identification numbers. The RE may inventory the cable, patch panels, and related equipment.
    - b. Storage and Handling: Store and protect equipment in a manner, which will preclude damage as directed by the RE.
  12. Where TCOs are installed adjacent to each other, install one outlet for each instrument.
  13. Equipment installed outdoors shall be weatherproof or installed in weatherproof enclosures with hinged doors and locks with two keys.
- B. Equipment Racks:
1. Fill unused equipment mounting spaces with blank panels or vent panels. Match color to equipment racks.
  2. Provide security covers for all devices not requiring routine operator control.
  3. Provide vent panels and cooling fans as required for the operation of equipment within the OEM' specified temperature limits. Provide adequate ventilation space between equipment for cooling. Follow manufacturer's recommendations regarding ventilation space between amplifiers.
  4. Provide insulated connections of the electrical raceway to equipment racks.
  5. Provide continuous raceway/conduit with no more than 40% fill between wire troughs and equipment racks for all non-plenum-rated cable. Ensure each system is mechanically separated from each other in the wireway.
  6. Ensure a minimum of 36 inches around each cabinet and/or rack to comply with OSHA Safety Standards. Cabinets and/or Racks installed side by side – the 36" rule applies to around the entire assembly
- C. Distribution Frames.
1. A new stand-alone (i.e., self-supporting, free-standing) PA rack/frame may be provided in each TR to interconnect the PA, TER, TCR, PCR, SCC, STRs & ECRs. Rack/frames shall be wired in accordance with industry standards and shall employ "latest state-of-the-art" modular cross-connect devices. The PA riser cable shall be sized to satisfy all voice/digital requirements plus not less than 50% spare (growth) capacity in each TR which includes a fiber optic backbone.
  2. The frames/racks shall be connected to the TER/MCR system ground.
- D. Wiring Practice - in addition to the MANDATORY infrastructure requirements outlined in VA Construction Specifications 27 10 00 – TIP Structured Communications Cabling, 27 11 00 – TIP Communications Rooms Fittings and 27 15 00 – TIP Horizontal and Vertical

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Communicators Cabling, the following additional practices shall be adhered to:

1. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
2. Execute all wiring in strict adherence to the National Electrical Code, applicable local building codes and standard industry practices.
3. Wiring shall be classified according to the following low voltage signal types:
  - a. Balanced microphone level audio (below -20dBm) or Balanced line level audio (-20dBm to +30dBm)
  - b. 70V audio speaker level audio.
  - c. Low voltage DC control or power (less than 48VDC)
4. Where raceway is to be EMT (conduit), wiring of differing classifications shall be run in separate conduit. Where raceway is to be an enclosure (rack, tray, wire trough, utility box) wiring of differing classifications which share the same enclosure shall be mechanically partitioned and separated by at least four (4) inches. Where Wiring of differing classifications must cross, they shall cross perpendicular to one another.
5. Do not splice wiring anywhere along the entire length of the run. Make sure cables are fully insulated and shielded from each other and from the raceway for the entire length of the run.
6. Do not pull wire through any enclosure where a change of raceway alignment or direction occurs. Do not bend wires to less than radius recommended by manufacturer.
7. Replace the entire length of the run of any wire or cable that is damaged or abraded during installation. There are no acceptable methods of repairing damaged or abraded wiring.
8. Use wire pulling lubricants and pulling tensions as recommended by the OEM.
9. Use grommets around cut-outs and knock-outs where conduit or chase nipples are not installed.
10. Do not use tape-based or glue-based cable anchors.
11. Ground shields and drain wires to the Facility's signal ground system as indicated by the drawings.
12. Field wiring entering equipment racks shall be terminated as follows:
  - a. Provide ample service loops at harness break-outs and at plates, panels and equipment. Loops should be sufficient to allow plates, panels and equipment to be removed for service and inspection.
  - b. Line level and speaker level wiring may be terminated inside the equipment rack using specified terminal blocks (see "Products.") Provide 15% spare terminals inside each rack. Microphone level wiring may only be terminated at the equipment served.
  - c. If specified terminal blocks are not designed for rack mounting, utilize  $\frac{3}{4}$ " plywood or  $\frac{1}{8}$ " thick aluminum plates/blank panels as a mounting surface. Do not mount on the bottom of the rack.
  - d. Employ permanent strain relief for any cable with an outside diameter of 1" or greater.
13. Use only balanced audio circuits unless noted otherwise
14. Make all connections as follows:
  - a. Make all connections using rosin-core solder or mechanical connectors appropriate to the application.
  - b. For crimp-type connections, use only tools that are specified by the manufacturer for the application.
  - c. Use only insulated spade lugs on screw terminals. Spade lugs shall be sized to fit the wire gauge. Do not exceed two lugs per terminal.
  - d. Wire nuts, electrical tape or "Scotch Lock" connections are not acceptable for any application.
15. Make all connections as follows:
  - a. Make all connections using rosin-core solder or mechanical connectors appropriate to the application.

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- b. For crimp-type connections, use only tools that are specified by the manufacturer for the application.
  - c. Use only insulated spade lugs on screw terminals. Spade lugs shall be sized to fit the wire gauge. Do not exceed two lugs per terminal.
  - d. Wire nuts, electrical tape or "Scotch Lock" connections are not acceptable for any application.
16. Noise filters and surge protectors shall be provided for each equipment interface cabinet, switch equipment cabinet, control console, local, and remote active equipment locations to ensure protection from input primary AC power surges and noise glitches are not induced into low Voltage data circuits.
17. Wires or cables previously approved to be installed outside of conduit, cable trays, wireways, cable duct, etc.:
- a. Only when specifically authorized as described herein, will wires or cables be identified and approved to be installed outside of conduit. The wire or cable runs shall be UL rated plenum and OEM certified for use in air plenums.
  - b. Wires and cables shall be hidden, protected, fastened and tied at 600 mm (24 in.) intervals, maximum, as described herein to building structure.
  - c. Closer wire or cable fastening intervals may be required to prevent sagging, maintain clearance above suspended ceilings, remove unsightly wiring and cabling from view and discourage tampering and vandalism. Wire or cable runs, not provided in conduit, that penetrate outside building walls, supporting walls, and two hour fire barriers shall be sleeved and sealed with an approved fire retardant sealant.
  - d. Wire or cable runs to system components installed in walls (i.e.: volume attenuators, circuit controllers, signal, or data outlets, etc.) may, when specifically authorized by the RE, be fished through hollow spaces in walls and shall be certified for use in air plenum areas.
  - e. Completely test all of the cables after installation and replace any defective cables.
  - f. Wires or cables that are installed outside of buildings shall be in conduit, secured to solid building structures. If specifically approved, on a case by case basis, to be run outside of conduit, the wires or cables shall be installed, as described herein. The bundled wires or cables must: Be tied at not less than 460 mm (18 in.) intervals to a solid building structure; have ultra violet protection and be totally waterproof (including all connections). The laying of wires or cables directly on roof tops, ladders, drooping down walls, walkways, floors, etc. is not allowed and will not be approved.
- E. Cable Installation - In addition to the MANDATORY infrastructure requirements outlined in VA Construction Specifications 27 10 00 – Structured TIP Communications Cabling, 27 11 00 – TIP Communications Rooms and Fittings and 27 15 00 – TIP Communications Horizontal and Vertical Cabling and the following additional practices shall be adhered to:
1. Support cable on maximum 2'-0" centers. Acceptable means of cable support are cable trays. Velcro wrap cable bundles loosely to the means of support with plenum rated Velcro straps. Plastic tie wraps are not acceptable as a means to bundle cables.
  2. Run cables parallel to walls.
  3. Install maximum of 10 cables in a single row. Provide necessary rows as required by the number of cables.
  4. Do not lay cables on top of light fixtures, ceiling tiles, mechanical equipment, or ductwork. Maintain at least 2'-0" clearance from all shielded electrical apparatus.
  5. All cables shall be tested after the total installation is fully complete. All test results are to be documented. All cables shall pass acceptable test requirements and levels. Contractor shall remedy any cabling problems or defects in order to pass or comply with testing. This includes the re-pull of new cable as required at no additional cost to the Owner.
  6. Ends of cables shall be properly terminated on both ends per industry and OEM's recommendations.

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7. Provide proper temporary protection of cable after pulling is complete before final dressing and terminations are complete. Do not leave cable lying on floor. Bundle and tie wrap up off of the floor until you are ready to terminate.
  8. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
  9. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.
  10. Bundle, lace, and train conductors to terminal points without exceeding OEM's limitations on bending radii. Install lacing bars and distribution spools.
  11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used.
  12. Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.
  13. Separation of Wires: (REFER TO RACEWAY INSTALLATION) Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 12 inches apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.
  14. Serve all cables as follows:
    - a. Cover the end of the overall jacket with a 1" (minimum) length of transparent heat-shrink tubing. Cut unused insulated conductors 2" (minimum) past the heat-shrink, fold back over jacket and secure with cable-tie. Cut unused shield/drain wires 2" (minimum) past the heatshrink and serve as indicated below.
    - b. Cover shield/drain wires with heat-shrink tubing extending back to the overall jacket. Extend tubing 1/4" past the end of unused wires, fold back over jacket and secure with cable tie.
    - c. For each solder-type connection, cover the bare wire and solder connection with heat-shrink tubing.
- F. Labeling: Provide labeling in accordance with ANSI/EIA/TIA-606-A. All lettering for PA circuits shall be stenciled using laser printers or thermal ink transfer process.
1. Cable and Wires (Hereinafter referred to as "Cable"): Cables shall be labeled at both ends in accordance with ANSI/EIA/TIA-606-A. Labels shall be permanent in contrasting colors. Cables shall be identified according to the System "Record Wiring Diagrams."
  2. Equipment: System equipment shall be permanently labeled with contrasting plastic laminate or Bakelite material. System equipment shall be labeled on the face of the unit corresponding to its source.
    - a. Clearly, consistently, logically and permanently mark switches, connectors, jacks, relays, receptacles and electronic and other equipment.
    - b. Engrave and paint fill all receptacle panels using 1/8" (minimum) high lettering and contrasting paint.
    - c. For rack-mounted equipment, use engraved Lamacoid labels with white 1/8" (minimum) high lettering on black background. Label the front and back of all rack-mounted equipment.
  3. Conduit, Cable Duct, and/or Cable Tray: The Contractor shall label all conduit, duct and tray, including utilized GFE, with permanent marking devices or spray painted stenciling a minimum of 3 meters (10 ft.) identifying it as the System. In addition, each enclosure shall be labeled according to this standard.
  4. Termination Hardware: The Contractor shall label TCOs and patch panel connections using color coded labels with identifiers in accordance with ANSI/EIA/TIA-606-A and the "Record Wiring Diagrams."
  5. Where multiple pieces of equipment reside in the same rack group, clearly and logically label each indicating to which room, channel, receptacle location, etc. they correspond.

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6. Permanently label cables at each end, including intra-rack connections. Labels shall be covered by the same, transparent heat-shrink tubing covering the end of the overall jacket. Alternatively, computer generated labels of the type which include a clear protective wrap may be used.
  7. Contractor's name shall appear no more than once on each continuous set of racks. The Contractor's name shall not appear on wall plates or portable equipment.
  8. Ensure each OEM supplied item of equipment has appropriate UL Labels / Marks for the service the equipment is performed permanently attached / marked. **SYSTEM EQUIPMENT INSTALLED NOT BEARING THESE UL MARKS WILL NOT BE ALLOWED TO BE A PART OF THE SYSTEM. THE CONTRACTOR SHALL BEAR ALL COSTS REQUIRED TO PROVIDE REPLACEMENT EQUIPMENT WITH APPROVED UL MARKS.**
- G. Conduit and Signal Ducts: When the Contractor and/or OEM determines additional system conduits and/or signal ducts are required in order to meet the system minimum performance standards outlined herein, the contractor shall provide these items as follows:
1. Conduit:
    - a. The Contractor shall employ the latest installation practices and materials. The Contractor shall provide conduit, junction boxes, connectors, sleeves, weather heads, pitch pockets, and associated sealing materials not specifically identified in this document as GFE. Conduit penetrations of walls, ceilings, floors, interstitial space, fire barriers, etc., shall be sleeved and sealed.
    - b. All cables shall be installed in separate conduit and/or signal ducts (exception from the separate conduit requirement to allow PA cables to be installed in partitioned cable tray with voice cables may be granted in writing by the RE if requested). Conduits shall be provided in accordance with Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and NEC Articles 517 for Critical Care and 800 for Communications systems, at a minimum.
    - c. When metal, plastic covered, etc., flexible cable protective armor or systems are specifically authorized to be provided for use in the System, their installation guidelines and standards shall be as specified herein, Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and the NEC.
    - d. When "interduct" flexible cable protective systems is specifically authorized to be provided for use in the System, it's installation guidelines and standards shall be as the specified herein, Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and the NEC.
    - e. Conduit fill (including GFE approved to be used in the system) shall not exceed 40%. Each conduit end shall be equipped with a protective insulator or sleeve to cover the conduit end, connection nut or clamp, to protect the wire or cable during installation and remaining in the conduit. Electrical power conduit shall be installed in accordance with the NEC. AC power conduit shall be run separate from signal conduit.
    - f. Ensure that Critical Care PA Systems (as identified by NEC Section 517) are completely separated and protected from all other systems.
  2. Signal Duct, Cable Duct, or Cable Tray:
    - a. The Contractor shall use GFE signal duct, cable duct, and/or cable tray, when identified and approved by the RE.
    - b. Approved signal and/or cable duct shall be a minimum size of 100 mm x 100 mm (4 in. X 4 in.) inside diameter with removable tops or sides, as appropriate. Protective sleeves, guides or barriers are required on all sharp corners, openings, anchors, bolts or screw ends, junction, interface and connection points.
    - c. Approved cable tray shall be fully covered, mechanically and physically partitioned for multiple electronic circuit use, and be UL certified and labeled for use with telecommunication circuits and/or systems. The RE shall approve width and height dimensions.



- d. All cable junctions and taps shall be accessible. Provide an 8" X 8" X 4" (minimum) junction box attached to the cable duct or raceway for installation of distribution system passive equipment. Ensure all equipment and tap junctions are accessible

### **3.05 PROTECTION OF NETWORK DEVICES**

- A. Contractor shall protect network devices during unpacking and installation by wearing manufacturer approved electrostatic discharge (ESD) wrist straps tied to chassis ground. The wrist strap shall meet OSHA requirements for prevention of electrical shock, should technician come in contact with high voltage.

### **3.06 CUTTING, CLEANING AND PATCHING**

- A. It shall be the responsibility of the contractor to keep their work area clear of debris and clean area daily at completion of work.
- B. It shall be the responsibility of the contractor to patch and paint any wall or surface that has been disturbed by the execution of this work.
- C. The Contractor shall be responsible for providing any additional cutting, drilling, fitting or patching required that is not indicated as provided by others to complete the Work or to make its parts fit together properly.
- D. The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate Contractor the Contractor's consent to cutting or otherwise altering the Work.
- E. Where coring of existing (previously installed) concrete is specified or required, including coring indicated under unit prices, the location of such coring shall be clearly identified in the field and the location shall be approved by the Project Manager prior to commencement of coring work.

### **3.07 FIREPROOFING**

- A. Where PA wires, cables and conduit penetrate fire rated walls, floors and ceilings, fireproof the opening.
- B. Provide conduit sleeves (if not already provided by electrical contractor) for cables that penetrate fire rated walls and Telecommunications Rooms floors and ceilings. After the cabling installation is complete, install fire proofing material in and around all conduit sleeves and openings. Install fire proofing material thoroughly and neatly. Seal all floor and ceiling penetrations.
- C. Use only materials and methods that preserve the integrity of the fire stopping system and its rating.
- D. Install fireproofing where low voltage cables are installed in the same manholes with high voltage cables; also cover the low voltage cables with arc proof and fireproof tape.
- E. Use approved fireproofing tape of the same type as used for the high voltage cables, and apply the tape in a single layer, one-half lapped or as recommended by the manufacturer. Install the tape with the coated side towards the cable and extend it not less than 25 mm (one inch) into each duct.
- F. Secure the tape in place by a random wrap of glass cloth tape.

### **3.08 GROUNDING**

- A. Ground PA cable shields and equipment to eliminate shock hazard and to minimize ground loops, common mode returns, noise pickup, cross talk, and other impairments as specified in CFM Division 27, Section 27 05 26 – Grounding and Bonding for Communications Systems.

- B. Facility Signal Ground Terminal: Locate at main room or area signal ground within the room (i.e. head end and telecommunications rooms) or area(s) and indicate each signal ground location on the drawings.
- C. Extend the signal ground to inside each equipment cabinet and/or rack. Ensure each cabinet and/or rack installed item of equipment is connected to the extended signal ground. Isolate the signal ground from power and major equipment grounding systems.
- D. When required, install grounding electrodes as specified in CFM Division 26, Section 26 05 26 –Grounding and Bonding for Electrical Systems.
- E. Do not use “3rd or 4th” wire internal electrical system conductors for communications signal ground.
- F. Do not connect the signal ground to the building’s external lightning protection system.
- G. Do Not “mix grounds” of different systems.
- H. Insure grounds of different systems are installed as to not violate OSHA Safety and NEC installation requirements for protection of personnel.

#### **PART 4 – TESTING / GUARANTY / TRAINING**

##### **SYSTEM LISTING**

- I. The PA System is NFPA listed as an “Emergency / Public Safety” Communications system. Where Code Blue signals are transmitted, that listing is elevated to “Life Support/Safety.” Therefore, the following testing and guaranty provisions are the minimum to be performed and provided by the contractor and OEM.

##### **PROOF OF PERFORMANCE TESTING**

- J. Intermediate Testing:
  - 1. After completion of 25 – 30% the installation of a head end cabinet(s) and equipment, one microphone console, local and remote enunciation stations, two (2) zones, two (2) sub zones prior to any further work, this portion of the system must be pretested, inspected, and certified. Each item of installed equipment shall be checked to ensure appropriate UL Listing and Certification Labels are affixed as required by NFPA -Life Safety Code 101-3.2 (a) & (b) and JCHCO evaluation guidelines, and proper installation practices are followed. The intermediate test shall include a full operational test.
  - 2. All inspections and tests shall be conducted by an OEM-certified contractor representative and witnessed by TVE-005OP3B if there is no local Government Representative that processes OEM and VA approved Credentials to inspect and certify the system. The results of the inspection will be officially recorded by the Government Representative and maintained on file by the RE, until completion of the entire project. The results will be compared to the Acceptance Test results. An identical inspection may be conducted between the 65 - 75% of the system construction phase, at the direction of the RE.
- K. Pretesting:
  - 1. Upon completing installation of the PA System, the Contractor shall align, balance, and completely pretest the entire system under full operating conditions.
  - 2. Pretesting Procedure:
    - a. During the System Pretest the Contractor shall verify (utilizing approved test equipment) that the System is fully operational and meets all the System performance requirements of this standard.
    - b. The Contractor shall pretest and verify that all PA System functions and specification requirements are met and operational, no unwanted aural effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise, etc. are present. At a minimum, each of the following locations shall be fully pretested:
      - 1) Central Control Cabinets.
      - 2) Local Control Stations.

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- 3) Zone Equipment/Systems.
  - 4) Sub-Zone Equipment/Systems.
  - 5) Remote Control Panels.
    - (a) TCR.
    - (b) PCR/SCC.
    - (c) ECR.
  - 6) All Networked locations.
  - 7) System interface locations (i.e. TELCO, two way radio, etc.).
  - 8) System trouble reporting.
  - 9) System Electrical Supervision.
  - 10) UPS operation.
  - 11) STRs.
  - 12) NSs
  - 13) TCOs.
3. The Contractor shall provide four (4) copies of the recorded system pretest measurements and the written certification that the System is ready for the formal acceptance test shall be submitted to the RE.
- L. Acceptance Test:
1. After the PA System has been pretested and the Contractor has submitted the pretest results and certification to the RE, then the Contractor shall schedule an acceptance test date and give the RE 30 day's written notice prior to the date the acceptance test is expected to begin. The System shall be tested in the presence of TVE 005OP3B and an OEM certified representatives. The System shall be tested utilizing the approved test equipment to certify proof of performance and Emergency / Public Safety compliance. The tests shall verify that the total System meets all the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.
  2. The acceptance test shall be performed on a "go-no-go" basis. Only those operator adjustments required to show proof of performance shall be allowed. The test shall demonstrate and verify that the installed System does comply with all requirements of this specification under operating conditions. The System shall be rated as either acceptable or unacceptable at the conclusion of the test. Failure of any part of the System that precludes completion of system testing, and which cannot be repaired in four (4) hours, shall be cause for terminating the acceptance test of the System. Repeated failures that result in a cumulative time of eight (8) hours to affect repairs shall cause the entire System to be declared unacceptable. Retesting of the entire System shall be rescheduled at the convenience of the Government.
  3. Retesting of the entire System shall be rescheduled at the convenience of the Government and costs borne by the Contractor at the direction of the SRE.
- M. Acceptance Test Procedure:
1. Physical and Mechanical Inspection:
    - a. The TVE 005OP3B Representative will tour all areas where the PA system and all sub-systems are completely and properly installed to insure they are operationally ready for proof of performance testing. A system inventory including available spare parts will be taken at this time. Each item of installed equipment shall be checked to ensure appropriate UL certification labels are affixed.
    - b. The System diagrams, record drawings, equipment manuals, TIP Auto CAD Disks, intermediate, and pretest results shall be formally inventoried and reviewed.
    - c. Failure of the System to meet the installation requirements of this specification shall be grounds for terminating all testing.
  2. Operational Test:
    - a. After the Physical and Mechanical Inspection, the system head end equipment shall be checked to verify that it meets all performance requirements outlined herein. A spectrum analyzer and sound level meter may be utilized to accomplish this

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- requirement.
  - b. Following the head end equipment test, each speaker (or on board speaker) shall be inspected to ensure there are no signal distortions such as intermodulation, data noise, popping sounds, erratic system functions, on any function.
  - c. The distribution system shall be checked at each interface, junction, and distribution point, first, middle, and last speaker in each leg to verify the PA distribution system meets all system performance standards.
  - d. If the RED system is a part of the system, each volume stepper switches shall be checked to insure proper operation of the pillow speaker, the volume stepper and the RED system (if installed).
  - e. Additionally, each installed head end equipment, microphone console; amplifier, mixer, distributed speaker/amplifier, monitor speaker, telephone interface, power supply and remote amplifiers shall be checked insuring they meet the requirements of this specification.
  - f. Once these tests have been completed, each installed sub-system function shall be tested as a unified, functioning and fully operating system. The typical functions are: "all call," three sub-zoned, minimum of 15 minutes of UPS operation, electrical supervision, trouble panel, corridor speakers and audio paging.
  - g. Individual Item Test: The TVE 005OP3B Representative will select individual items of equipment for detailed proof of performance testing until 100% of the System has been tested and found to meet the contents of this specification. Each item shall meet or exceed the minimum requirements of this document.
3. Test Conclusion:
- a. At the conclusion of the Acceptance Test, using the generated punch list (or discrepancy list) the VA and the Contractor shall jointly agree to the results of the test, and reschedule testing on deficiencies and shortages with the RE. Any retesting to comply with these specifications will be done at the Contractor's expense.
  - b. If the System is declared unacceptable without conditions, all rescheduled testing expenses will be borne by the Contractor.
- N. Acceptable Test Equipment: The test equipment shall be furnished by the Contractor and shall have a calibration tag of an acceptable calibration service dated not more than 12 months prior to the test. As part of the submittal, a test equipment list shall be furnished that includes the make and model number of the following type of equipment as a minimum:
- 1. Spectrum Analyzer.
  - 2. Signal Level Meter.
  - 3. Volt-Ohm Meter.
  - 4. Sound Pressure Level (SPL) Meter.
  - 5. Oscilloscope.
  - 6. Random Noise Generator.
  - 7. Audio Amplifier with External Speaker.

**WARRANTY**

- O. Comply with FAR 52.246-21, except that warranty shall be as follows:
- P. Contractor's Responsibility:
  - 1. The Contractor shall warranty that all provided material and equipment will be free from defects, workmanship and will remain so for a period of two (2) years from date of final acceptance of the System by the VA. The Contractor shall provide OEM's equipment warranty documents, to the RE (or Facility Contracting Officer if the Facility has taken possession of the building), that certifies each item of equipment installed conforms to OEM published specifications.
  - 2. The Contractor's maintenance personnel shall have the ability to contact the Contractor and OEM for emergency maintenance and logistic assistance, remote diagnostic testing, and assistance in resolving technical problems at any time. This contact capability shall be

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- provided by the Contractor and OEM at no additional cost to the VA.
3. All Contractor maintenance and supervisor personnel shall be fully qualified by the OEM and must provide two (2) copies of current and qualified OEM training certificates and OEM certification upon request.
  4. Additionally, the Contractor shall accomplish the following minimum requirements during the two year guaranty period:
    - a. Response Time During the Two Year Guaranty Period:
      - 1) The RE (or Facility Contracting Officer if the system has been turned over to the Facility) is the Contractor's ONLY OFFICIAL reporting and contact official for nurse call system trouble calls, during the guaranty period.
      - 2) A standard work week is considered 8:00 A.M. to 5:00 P.M. or as designated by the RE (or Facility Contracting Officer), Monday through Friday exclusive of Federal Holidays.
      - 3) The Contractor shall respond and correct on-site trouble calls, during the standard work week to:
        - (a) A routine trouble call within one (1) working day of its report. A routine trouble is considered a trouble which causes a power supply; one (1) master System control station, microphone console or amplifier to be inoperable.
        - (b) Routine trouble calls in critical emergency health care facilities (i.e., cardiac arrest, intensive care units, etc.) shall also be deemed as an emergency trouble call. The RE (or Facility Contracting Officer) shall notify the Contractor of this type of trouble call.
        - (c) An emergency trouble call within four (4) hours of its report. An emergency trouble is considered a trouble which causes a sub-zone, zone, distribution point, terminal cabinet, or all call system to be inoperable at any time.
      - 4) If a PA System component failure cannot be corrected within four (4) hours (exclusive of the standard work time limits), the Contractor shall be responsible for providing alternate System equipment. The alternate equipment/system shall be operational within a maximum of 12 hours after the four (4) hour trouble shooting time and restore the effected location operation to meet the System performance standards. If any sub-system or major system trouble cannot be corrected within one working day, the Contractor shall furnish and install compatible substitute equipment returning the System or sub-system to full operational capability, as described herein, until repairs are complete.
    - b. Required On-Site Visits During the Two Year Guaranty Period
      - 1) The Contractor shall visit, on-site, for a minimum of eight (8) hours, once every 12 weeks, during the guaranty period, to perform system preventive maintenance, equipment cleaning, and operational adjustments to maintain the System according the descriptions identified in this document.
      - 2) The Contractor shall arrange all Facility visits with the RE (or Facility Contracting Officer) prior to performing the required maintenance visits.
      - 3) Preventive maintenance procedure(s) shall be performed by the Contractor in accordance with the OEM's recommended practice and service intervals during non-busy time agreed to by the RE (or Facility Contracting Officer) and Contractor.
      - 4) The preventive maintenance schedule, functions and reports shall be provided to and approved by the RE (or Facility Contracting Officer).
      - 5) The Contractor shall provide the RE (or Facility Contracting Officer) a type written report itemizing each deficiency found and the corrective action performed during each required visit or official reported trouble call. The Contractor shall provide the RE with sample copies of these reports for review and approval at the beginning of the Acceptance Test. The following reports are the minimum required:

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- (a) The Contractor shall provide a monthly summary all equipment and sub-systems serviced during this warranty period to RE (or Facility Contracting Officer) by the fifth (5th) working day after the end of each month. The report shall clearly and concisely describe the services rendered, parts replaced and repairs performed. The report shall prescribe anticipated future needs of the equipment and systems for preventive and predictive maintenance.
  - (b) The Contractor shall maintain a separate log entry for each item of equipment and each sub-system of the System. The log shall list dates and times of all scheduled, routine, and emergency calls. Each emergency call shall be described with details of the nature and causes of emergency steps taken to rectify the situation and specific recommendations to avoid such conditions in the future.
- 6) The RE (or Facility Contracting Officer) shall convey to the Facility Engineering Officer, two (2) copies of actual reports for evaluation.
- (a) The RE (or Facility Contracting Officer) shall ensure a copy of these reports is entered into the System's official acquisition documents.
  - (b) The Facility Chief Engineer shall ensure a copy of these reports is entered into the System's official technical record documents.
- Q. Work Not Included: Maintenance and repair service shall not include the performance of any work due to improper use; accidents; other vendor, contractor, or owner tampering or negligence, for which the Contractor is not directly responsible and does not control. The Contractor shall immediately notify the RE or Facility Contracting Officer in writing upon the discovery of these incidents. The RE or Facility Contracting Officer will investigate all reported incidents and render an official opinion in writing concerning the supplied information.

**TRAINING**

- R. Provide thorough training of all biomed engineering and electronic technical staff assigned to those nursing units receiving new networked nurse/patient communications equipment. This training shall be developed and implemented to address two different types of staff. Floor nurses/staff shall receive training from their perspective, and likewise, unit secretaries (or any person whose specific responsibilities include answering patient calls and dispatching staff) shall receive operational training from their perspective. A separate training room will be set up that allows this type of individualized training utilizing in-service training unit, prior to cut over of the new system.
- S. Provide the following minimum training times and durations:
- 1. 48 hours prior to opening for BME / Electronic Staff (in 8-hour increments) – split evenly over 3 weeks and day and night shifts. Coordinate schedule with Owner.
  - 2. 32 hours during the opening week for Telephone Staff – both day and night shifts.
  - 3. 24 hours for supervisors and system administrators.

**END OF SECTION**

**SECTION 275123**  
**INTERCOMMUNICATIONS AND PROGRAM SYSTEMS**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

- A. This section specifies a new and fully operating Intercom (IC) System.
- B. Conform to VAAR 852.236.91 and intent of the construction documents, recognizing that it may be impracticable to detail all items because of variances in manufacturers to achieve indicated intent.

**1.02 RELATED WORK**

- A. Connection to Electronic Access Control at doors: Section 28 13 00, PHYSICAL ACCESS CONTROL SYSTEM.
- B. Door hardware and operation of doors: 08 71 00 DOOR HARDWARE
- C. Conduit and boxes: Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- D. Electrical conductors and cables: Section 27 10 00, CONTROL, COMMUNICATION AND SIGNAL WIRING.
- E. Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- F. When interfaced for Security Emergency Communications: Section 28 52 31, EMERGENCY CALL SYSTEM.
- G. Requirements for interfacing with Facility's SMS: Section 28 31 00, PHYSICAL ACCESS CONTROL SYSTEM.

**1.03 SUBMITTALS**

- A. In addition to requirements of SECTION 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS, submit:
  - 1. Written certification from OEM proposed provider of contract maintenance is an authorized representative of OEM. Include provider's legal name, address, and OEM credentials.
  - 2. Submit names, locations and point of contact for three installations employing proposed OEM IC Systems of comparable size and complexity performing for at least one year after final acceptance by user.
- B. Certifications:
  - 1. Submit documentation that supplier has been an authorized distributor and service organization for OEM for a minimum of three years and is authorized by OEM to pass thru OEM's warranty of installed equipment to Government.
  - 2. Submit certificate of successful completion of OEM's installation and training program for each installing technician of equipment being proposed. Provide current OEM certifications for installers to be approved by COR before being allowed to commence work on system.
  - 3. Provide current OEM certification documenting maintenance and supervisory personnel are authorized by OEM to service installed equipment during warranty.
  - 4. Furnish copies of applicable national, state and local licenses.
- C. Warranty: Submit OEM warranty.
- D. Needs Assessment Report: Provide a summary report of the needs assessment meeting conducted with nursing manager of each unit, as required by this section.
- E. Maintenance Material Submission:
  - 1. Provide one spare 304 m (1,000 foot) roll of accepted system (not microphone) cable.

#### 1.04 QUALITY ASSURANCE

- A. Assign only technicians trained, qualified, and certified by OEM on engineering, installation, operation and testing of system.
- B. Provide system firmware from OEM with a proven history of product reliability and sole control over all source code.

#### 1.05 WARRANTY

- A. Comply with FAR clause 52.246-21, except that warranty must be as follows:
  - 1. Manufacturer shall warranty their equipment and certified installation for a minimum of two years from date of installation and final acceptance by the Government.
  - 2. Provide, free of charge, product firmware and software upgrades for a period of one year from date of final acceptance by Government for any product feature enhancements.

### PART 2 PRODUCTS

#### 2.01 GENERAL

- A. Provide voice communication between wall-mounted intercom stations and desk or wall-mounted master stations.
- B. Provide accessories and miscellaneous appurtenances required for a complete and operating communications system and network.
- C. Coordinate features and select components to form an integrated IC system. Match components and interconnections for optimum performance of specified functions.
- D. Expansion Capability: Increase number of Room Speaker-Microphone stations in future by 25 percent above those indicated without adding any internal or external components or trunk cable conductors.
- E. Equipment: Modular type, continuous duty rated.
- F. Weather-Resistant Equipment: Listed by a National Recognized Testing Laboratory (NRTL) for operation in wet, damp or outdoor locations.
- G. Install IC head end equipment in room and connect rooms // \_\_\_\_\_ //. Provide zoned, one-way voice paging through distributed, wall-mounted units. Interconnect so voice input into IC is by zone from main console at // \_\_\_\_\_ //.

#### 2.02 PERFORMANCE CRITERIA

- A. In addition to requirements of Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS, the minimum requirements for each system are:
  - 1. Wired IC systems approved to connect to separate communications system (i.e. SMS, WAN, LAN includes: Telephone, Nurse Call, radio paging, wireless systems) minimum requirements:
    - a. NIST FIPS Pub 140/2.
    - b. UL 60950-1, edition 2.
  - 2. IEC 62368-1 ed 2: 2014.
  - 3. Code of Federal Regulations, Title 47, Part 15 (or FCC Part 15) Listed Radio Equipment is not permitted.
- B. Provide system with configuration programming capable of being executed remotely via a remote connection (when specifically accepted by Spectrum Management and COMSEC Services (SMCS 0050P2H3) without any exchange of parts.

#### 2.03 EQUIPMENT ITEMS

- A. Manually Switched System:
  - 1. Master Station Features:
    - a. Communicate selectively with all other master and speaker-microphone stations by actuation of selector switches.



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- b. Communicate simultaneously with other stations by actuation of a single all-call switch.
  - c. Communicate with individual stations in privacy.
  - d. Include other master-station connections in a multiple-station conference call.
  - e. Override any conversation by a designated master station.
  - 2. Room Speaker-Microphone Station Features:
    - a. Privacy from remote monitoring with a warning tone signal and visual indication at monitored station.
    - b. Privacy switches at designated speaker-microphone stations to prevent another station from listening and to permit incoming calls.
    - c. Communicate hands free.
    - d. Call master station by actuating call switch.
    - e. Return busy signal to indicate that station is already in use.
  - 3. Speakers: Free of noise and distortion during operation and when in standby mode.
- B. Microprocessor-Switched System:
- 1. Master Station Features:
    - a. Communicate selectively with other master and speaker-microphone stations by dialing station's number on a 12-digit keypad.
    - b. Communicate simultaneously with all other stations by dialing a designated number on a 12-digit key-pad.
    - c. Communicate with individual stations in privacy.
    - d. Include other master-station connections in a multiple-station conference call.
    - e. Access separate paging speakers or groups of paging speakers by dialing designated numbers on a 12-digit keypad.
    - f. Override any conversation by a designated master station.
    - g. Display selected station.
    - h. Volume Control: Regulate incoming-call volume.
    - i. LED: Identify calling stations and stations in use. Remains illuminated until call is answered.
    - j. Momentary audible tone signal: Announce incoming calls.
    - k. Handset with Hook Switch: Telephone type with 61 cm (24-inch) long, permanently coiled cord. Hook switch to disconnect speaker when handset is lifted.
    - l. Reset Control: Cancels call and resets system for next call.
  - m. Equipment Cabinet:
    - 1) Comply with EIA/ECA 310-E Cabinets, and Associated Equipment Standard.
    - 2) Lockable.
    - 3) Ventilated metal cabinet houses terminal strips, power supplies, amplifiers, system volume control, and other switching and control devices required for conversation channels and control functions.
  - n. Vertical Equipment Rack:
    - 1) 28-inch (16RU) rack space.
      - (a) Welded steel construction.
      - (b) Minimum 198 cm (78 inches) usable height.
      - (c) Adjustable front mounting rails.
    - 2) Install the following appurtenances provided by same manufacturer or as specified:
      - (a) Security screws w/ nylon isolation bushings.
      - (b) Textured blank panels.
      - (c) Custom mounts for components without rack mount kits.
      - (d) Security covers.
      - (e) Copper Bus Bar.

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- (f) Power Sequencer- rack-mounted power conditioner // and delayed sequencers // with two unswitched outlets // each // and contact closure control inputs.
- 2. Room Speaker-Microphone Station Features:
  - a. Privacy from remote monitoring with a warning tone signal and visual indication at monitored station.
  - b. Privacy switches at designated speaker-microphone stations to prevent another station from listening and to permit incoming calls.
  - c. Communicate hands free.
  - d. Call master station by actuating call switch.
  - e. Return busy signal to indicate that station is already in use.
  - f. Free of noise and distortion during operation and when in standby mode.
- C. Wireless:
  - 1. Radio Systems:
    - a. Provide IC system with ability to operate only with VA certified and licensed radio system (FCC Part 15 listed pagers and transmitters are not allowed for "Safety of Life" functions or installed in those specific areas) and with the following features:
      - 1) Ability to pass-through location information (such as a room number) and call-type as well as other text messages simultaneously to shift supervisor identified staff members.
      - 2) Allow operator to select staff members by name or pager number and select system message consisting of room number and condition code (such as priority level) or type text to be read by holder of pager unit.
      - 3) While a patient station is connected to nurse's master station, allow operator to automatically page staff member assigned to that room.
        - (a) An alternate staff member can be selected for paging purposes in place of primary staff member.
        - (b) Allow alternate staff member to be paged when primary staff member is unable to respond to patient's needs within a specified period of time.
        - (c) Assign any bed to any pager or pager group.
        - (d) Assign an unlimited amount of pagers to any patient bed.
      - 4) Ability to send code calls to staff members by predetermined group automatically by pressing one "Code Blue" button.
        - (a) Indicate room number of code call.
        - (b) State "Code Blue" in plain English format on pagers
        - (c) FCC Part 15 listed pagers are not allowed to be used for these" functions or in those specific locations.
  - 2. Personal Wireless Communicator:
    - a. Connect to personal wireless communications system.
    - b. Pass text data.
    - c. Provides 2-way communication between Telephone or LAN/WAN Interface.
    - d. Not FCC Part 15 listed device.
    - e. Meets or exceeds UL 60950-1, edition 2.
    - f. Meets Office of Cyber and Information Security (OCIS) Guide Lines for NIST FIPS Pub 140/2 certification.
    - g. Includes training program with recertifications for staff.

#### **2.04 HEAD END EQUIPMENT**

- A. Provide required power supplies, communications hubs, network switches, intelligent controllers and other devices necessary to form a complete system.
- B. Head end components can be rack mounted or wall mounted in a metal enclosure.
- C. Provide head end equipment in telecommunications room where IC system is installed.

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- D. Provide minimum 30 minute battery back-up (or UPS) to system components.
- E. Provide complete IC System electronic supervision from Facility Police SMS Console in Police Control Room; and interface Emergency (or Disaster Control Room) Console with alternate control capability.

**2.05 SYSTEM CABLES**

- A. Comply with SECTION 27 10 00, CONTROL, COMMUNICATION AND SIGNAL WIRING for specific installation and testing requirements.
- B. Conductors: Jacketed, twisted pair and twisted multipair, untinned solid copper; sizes as recommended by system manufacturer, but no smaller than No. 22 AWG.
- C. Insulation: Thermoplastic; minimum 0.8 mm (1/32 inch) thick.
- D. Shielding: For speaker-microphone leads and elsewhere where recommended by manufacturer; No. 34 AWG, tinned, soft-copper strands formed into a braid or equivalent foil.
- E. Minimum Shielding Coverage on Conductors: 60 percent.
- F. Cabling must be riser rated plenum rated in designated spaces.

**2.06 RACEWAYS**

- A. Raceways and Boxes: Comply with requirements in Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- B. Each open top raceway must be NRTL listed for telecommunications systems and partitioned with metal partitions in order to comply with NEC Parts 517 and 800 to "mechanically separate" telecommunications systems of different service, protect installed cables from falling out when vertically mounted and allow junction boxes to be attached to the side to interface "drop" type conduit cable feeds.
- C. IC System Cable Infrastructure: EMT and cable tray NRTL classified for suitability and NRTL listed for telecommunications.
- D. Pull boxes must be minimum 63.5 mm (2-1/2 inches) deep and 152.4 mm (6 inches) wide by 152.4 (6 inches) long.

**2.07 SYSTEM CONDUIT**

- A. Provide separate 25.4 mm (1 inch) minimum diameter conduit, for system installation.

**2.08 UNINTERRUPTIBLE POWER SUPPLY (UPS)**

- A. Provide UPS for system to allow normal operation and function (as if there was no AC power failure) in event of an AC power failure or during input power fluctuations for a minimum of 30 minutes.
- B. As an alternative solution, telephone system UPS can be utilized to meet this requirement at head-end location, as long as this function is specifically accepted by telephone contractor and COR.
  - 1. Do not make any attachments or connection to telephone system until specifically directed to do so, in writing, by COR.
- C. Provide UPS for active system components including:
  - 1. System Amplifiers.
  - 2. Microphone Consoles.
  - 3. System Interface Units.
  - 4. Head End Equipment Racks.
  - 5. Control Consoles.

**2.09 FINISHES**

- A. Provide finishes for exposed work such as plates, racks, panels, speakers, etc. accepted by design professional, COR and 005OP3B.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Review and coordinate with telecommunications cabling installer for location of intercom equipment in Telecommunications Rooms.
- B. Verification of Conditions: Before beginning work, verify location, quantity, size and access for the following:
  - 1. Isolated ground AC power circuits provided for systems.
  - 2. Pull boxes, wall boxes, wire troughs, conduit stubs and other related infrastructure for systems.
  - 3. System components installed by others.
  - 4. Overhead supports and rigging hardware installed by others.
- C. Installer must immediately notify COR, general contractor and design professional in writing of any discrepancies.
- D. Needs Assessment:
  - 1. Provide a one-on-one meeting with nursing manager of each unit affected by installation of system.
  - 2. Review floor plans and drawings, educate nursing manager on functions of the equipment and gather details specific to individual units; coverage and priorities of calls; staffing patterns; and other pertinent details that affect system programming and training.
  - 3. Prepare a summary report of the assessment.

### **3.02 INSTALLATION**

- A. General:
  - 1. Install work plumb and square and in a manner consistent with standard industry practice.
  - 2. Protect work from dust, paint and moisture as dictated by site conditions. Contractor is responsible for protection of work until final acceptance by Government.
  - 3. Install equipment according to OEM's recommendations.
  - 4. Provide any hardware, adaptors, brackets, rack mount kits or other accessories recommended by OEM for complete assembly and installation.
  - 5. Secure equipment firmly in place, including IC stations, speakers, equipment racks, system cables, etc.:
    - a. Supports, mounts, fasteners, attachments and attachment points must support loads with a safety factor of at least 5:1.
    - b. Do not impose weight of equipment on supports provided for other trades or systems.
    - c. Any suspended equipment or associated hardware must be certified by OEM for overhead suspension.
    - d. Contractor is responsible for means and methods in design, fabrication, installation and certification of any supports, mounts, fasteners and attachments.
  - 6. Coordinate cover plates with field conditions. Size and install cover plates to hide joints between back boxes and surrounding wall. Do not allow cable to leave or enter boxes without cover plates installed.
  - 7. Where cover plates are not fitted with connectors, provide grommeted holes in size and quantity required.
- B. Equipment Racks:
  - 1. Fill unused equipment mounting spaces with blank panels or vent panels; match color to equipment racks.
  - 2. Provide security covers for devices not requiring routine operator control.
  - 3. Provide vent panels and cooling fans as required for operation of equipment within OEM's specified temperature limits.
    - a. Provide adequate ventilation space between equipment for cooling.

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- b. Follow manufacturer's recommendations regarding ventilation space between amplifiers.
    4. Provide insulated connections of raceway to equipment racks.
    5. Provide continuous conduit with no more than 40 percent fill between wire troughs and equipment racks for non-plenum-rated cable.
    6. Ensure each system is mechanically separated from each other in wireway.
  - C. Wiring Practice: In addition to requirements in Section 27 10 00, STRUCTURED CABLING, adhere to the following additional practices:
    1. Execute wiring in strict adherence to National Electrical Code, applicable local building codes and standard industry practices.
    2. Where raceway and wire way are EMT (conduit), wiring of differing classifications must be run in separate conduit.
    3. Where raceway and wire way are an enclosure (rack, tray, wire trough, utility box) wiring of differing classifications which share same enclosure must be mechanically partitioned and separated by 102 mm (four inches). Where wiring of differing classifications must cross, they must cross perpendicular to one another.
    4. Do not splice wiring anywhere along entire length of run.
    5. Make sure cables are insulated and shielded from each other and from raceway for entire length of run.
    6. Do not pull wire through any enclosure where a change of raceway alignment or direction occurs.
    7. Do not bend wires to less than radius recommended by manufacturer.
    8. Replace entire length of run of any wire or cable that is damaged or abraded during installation. There are no acceptable methods of repairing damaged or abraded wiring.
    9. Do not apply wire pulling lubricants unless specifically recommended by cable OEM.
    10. Use grommets around cut-outs and knock-outs where conduit or chase nipples are not installed.
    11. Do not use tape-based or glue-based cable anchors.
    12. Bond shields and drain wires to ground.
    13. Terminate field wiring entering equipment racks as follows:
      - a. Provide service loops at harness break-outs, plates, panels and equipment to allow plates, panels and equipment to be removed for service and inspection.
      - b. Line level and speaker level wiring can be terminated inside equipment rack using specified terminal blocks.
      - c. Provide 15 percent spare terminals inside each rack.
      - d. Microphone level wiring can only be terminated at equipment served.
      - e. If specified terminal blocks are not designed for rack mounting, utilize 3/4 inch plywood or 1/8 inch thick aluminum plates/blank panels as a mounting surface.
      - f. Do not mount terminal blocks on bottom of rack.
      - g. Employ permanent strain relief for any cable with an outside diameter of 1 inch or greater.
    14. Use only balanced audio circuits unless indicated otherwise.
    15. Make connections as follows:
      - a. Use rosin-core solder or mechanical connectors appropriate to application.
      - b. For crimp-type connections, use only crimp tool specified by manufacturer for the application.
      - c. Use only insulated spade lugs on screw terminals. Spade lugs must be sized to fit wire gauge; do not exceed two lugs per terminal.
      - d. Twist on wire connectors and electrical tape are not permitted for any application.
  - D. Cable Installation: In addition to requirements in Section 27 10 00, STRUCTURED CABLING, comply to the following practices.

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1. Acceptable means of cable support are cable tray, wire way, and conduit. Hook and loop wrap cable bundles loosely to cable tray with plenum rated Velcro straps. Plastic tie wraps are not permitted as a means to bundle or support cables.
  2. Run cables parallel to walls.
  3. Do not lay cables on top of luminaires, ceiling tiles, mechanical equipment, or ductwork.
  4. Maintain minimum 61 cm (2'-0") clearance from all shielded electrical apparatus.
  5. Test cables after the total installation is complete. Document test results. Remedy any cabling problems or defects in order to pass or comply with testing. This includes re-pull of new cable as required.
  6. Terminate both ends of cables per industry and OEM's recommendations.
  7. Provide proper temporary protection of cable after pulling is complete before final dressing and terminations are complete. Do not leave cable lying on floor. Bundle and tie wrap up off of the floor until ready to terminate.
  8. Cover end of overall jacket with minimum 25.4 mm (1 inch) length of transparent heat-shrink tubing.
    - a. Cut unused insulated conductors minimum 50.8 mm (2 inches) passed heat-shrink, fold back over jacket and secure with cable-tie.
    - b. Cut unused shield/drain wires minimum 50.8 mm (2 inches) passed heat-shrink cover shield/drain wires with heat-shrink tubing extending to overall jacket. Extend tubing 6 mm (1/4 inch) passed end of unused wires, fold back over jacket and secure with cable tie.
  9. For each solder-type connection, cover bare wire and solder connection with heat-shrink tubing.
  10. Terminate conductors; no cable must contain unterminated elements. Make terminations only at outlets and terminals.
  11. Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables cannot be spliced.
  12. Bundle, lace, and train conductors to terminal points without exceeding OEM's limitations on bending radii. Install lacing bars and distribution spools.
  13. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps are not permitted.
  14. Cable must not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.
  15. Separation of Wires: (Refer to Raceway Installation)
    - a. Separate speaker-microphone, line-level, speaker-level, and power wiring runs.
    - b. Install in separate raceways or, where exposed or in same enclosure, separate conductors at minimum 30.5 cm (12 inches) apart for speaker microphones and adjacent parallel power and telephone wiring.
    - c. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.
- E. System Conduit: Install manufactured conduit sweeps and long radius elbows according to wire and cable OEM instructions.
- F. Labeling:
1. Permanently mark switches, connectors, jacks, relays, receptacles and electronic and other equipment.
  2. Engrave and paint fill receptacle panels using minimum 3.17 mm (1/8 inch) high lettering and contrasting paint.
  3. For rack-mounted equipment, use engraved Lamacoid labels with white minimum 3.17 mm (1/8 inch) high lettering on black background. Label front and back of rack-mounted equipment.
  4. Where multiple pieces of equipment reside in same rack group, label each indicating to which room, channel, receptacle location, etc. they correspond.

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5. Permanently label cables at each end, including intra-rack connections. Labels must be covered by same, transparent heat-shrink tubing covering end of overall jacket. Alternatively, provide computer generated labels of type which include a clear protective wrap.
  6. Contractor's name cannot appear more than once on each continuous set of racks. Contractor's name cannot appear on wall plates or portable equipment.
  7. Ensure each piece of OEM supplied equipment has appropriate NRTL labels for the service equipment is performing. Equipment installed not bearing NRTL label will not be permitted. Contractor is responsible to provide listed replacement equipment with approved NRTL label.
- G. Protection during Installation:
1. Protect electronic devices during unpacking and installation by wearing electrostatic discharge (ESD) wrist straps tied to chassis ground.
  2. Wrist straps must meet OSHA requirements for prevention of electrical shock, if technician comes in contact with high voltage.
- H. Cutting and Patching:
1. Keep work area clear of debris and clean area daily at completion of work.
  2. Patch and paint any wall or surface that has been disturbed by execution of this work.
  3. Provide any additional cutting, drilling, fitting or patching required that is not indicated as provided by others to complete work or to make its parts fit together properly.
  4. Do not damage or endanger fully or partially completed construction of Government or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. Contractor cannot cut or otherwise alter such construction by facility or separate contractor except with written consent of Government or of such separate contractor; such consent cannot be unreasonably withheld. Contractor cannot unreasonably withhold consent to cutting or otherwise altering work, by facility or a separate contractor.
  5. Where coring of in-place concrete is specified or required, including coring indicated under unit prices, location of such coring must be identified in the field and accepted by COR prior to commencement of coring work.
- I. Fireproofing:
1. Fireproof openings where IC cables penetrate fire rated walls, floors and ceilings.
  2. Provide conduit sleeves (if not already provided) for cables that penetrate fire rated walls and floors and ceilings. After cabling installation is complete, install fire proofing material in and around conduit sleeves and openings. Install fire proofing material thoroughly and neatly. Seal floor and ceiling penetrations.
  3. Use only materials and methods that preserve integrity of fire stopping system and its rating.
- J. Grounding:
1. Provide grounding system per Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
  2. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common mode returns, noise pickup, cross talk, and other impairments.
  3. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.
  4. Install grounding electrodes as specified in Section 27 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
  5. Do not use "3rd or 4th" wire internal electrical system conductors for ground.
  6. Do not connect system ground to building's external lightning protection system.
  7. Do not "mix grounds" of different systems.

### 3.03 FIELD QUALITY CONTROL

- A. Assign only technicians trained, qualified, and certified by OEM on engineering, installation, operation, and testing of system.
- B. Performance Testing:
  - 1. Intermediate Testing:
    - a. After completion of 25 percent of installation of equipment, including one master station, and remote station, and prior to any further work, this portion of system must be pretested, inspected, and certified. Check each item of installed equipment to ensure appropriate NRTL labels are affixed, NFPA, Life Safety, and Joint Commission guidelines are followed, and proper installation practices are followed. Include a full operational test.
    - b. Arrange for inspection and test conducted by a factory-certified representative to be witnessed by Government and SMCS 005OP2H3 at a minimum and COR. An identical inspection can be conducted between 65 and 75 percent of system construction phase, at direction of COR.
  - 2. Pretesting:
    - a. Upon completing installation of system:
      - 1) Align, balance, and completely pretest entire system under full operating conditions.
      - 2) Verify (utilizing approved test equipment) system is operational and meets performance requirements of this standard.
      - 3) Verify that system functions are operational, and no unwanted aural effects, (e.g. signal distortion, noise pulses, glitches, audio hum, poling noise, etc.) are present. At a minimum, pretest each of the following locations:
        - (a) Networked locations.
        - (b) System trouble reporting.
        - (c) System electrical supervision.
        - (d) UPS operation.
    - b. Provide recorded system pretest measurements and written certification that system is ready for formal acceptance test to COR.
  - 3. Acceptance Test:
    - a. Schedule acceptance test date giving COR 30 days' written notice prior to date acceptance test is expected to begin. System must be tested in the presence of a Government representative and OEM-certified representative. System must be tested utilizing approved test equipment to certify proof of performance and emergency compliance. Test must verify that the total system meets specification requirements. Notification of acceptance test must include expected duration of time of the test.
  - 4. Acceptance Test Procedure:
    - a. Physical and Mechanical Inspection:
      - 1) Government representative may tour areas where system and sub-systems are completely and properly installed to ensure they are operationally ready for proof of performance testing. Prepare system inventory including available spare parts. Each item of installed equipment must be checked to ensure appropriate NRTL labels are affixed.
      - 2) System diagrams, record drawings, equipment manuals, Auto CAD Disks, intermediate, and pretest results must be inventoried and reviewed.
      - 3) Failure of system to meet installation requirements of this specification can be grounds for terminating all testing.
    - b. Operational Test:
      - 1) Contractor must demonstrate full functionality of system including:
        - (a) Station to master calls.
        - (b) Station to station calls.



- (c) Broadcast calls.
- (d) Location identification of stations at intercom master station.
- c. Test Conclusion: Government will accept results of the test or require additional testing on deficiencies and shortages. Retesting to comply with these specifications must be done at Government's convenience and contractor's expense.

### **3.04 TRAINING**

- A. Provide training of facility-identified staff assigned to units receiving communications by an IC system. Implement training from master console operator's perspective, and likewise, for any person whose specific responsibilities include answering IC calls and dispatching an appropriate response, provide operational training from their perspective. A separate training room may be set up that allows this type of individualized training utilizing in-service training unit, prior to cut over of new system.
- B. Provide the following minimum training times and durations:
  - 1. 24 hours prior to facility opening,
  - 2. 24 hours during the standard work week, and
  - 3. 24 hours for supervisors and system administrators.

### **3.05 MAINTENANCE**

- A. Provide Government personnel with ability to contact contractor and OEM for maintenance and logistic assistance, remote diagnostic testing, and assistance in resolving technical problems at any time, during warranty period.
- B. Response Time during Warranty Period:
  - 1. COR is contractor's only official reporting and contact official for IC system trouble calls, during the warranty period.
  - 2. A standard work week is considered 8:00 A.M. to 5:00 P.M. or as designated by COR, Monday through Friday exclusive of Federal holidays.
  - 3. Respond and correct on-site trouble calls, during the standard work week:
    - a. A routine trouble call within one working day of its report. A routine trouble is considered a trouble which causes one IC station, or master IC station to be inoperable.
    - b. An emergency trouble call within four hours of its report.
      - 1) An emergency trouble is considered a trouble which causes an IC sub system or equipment cabinet, to be inoperable at any time.
      - 2) Emergency trouble calls include routine trouble calls in critical emergency health care facilities (i.e., cardiac arrest, intensive care units, etc.). COR must notify contractor of this type of trouble call.
  - 4. If an IC component failure cannot be corrected within four hours (exclusive of the standard work time limits), provide alternate IC equipment.
  - 5. Complete installation of alternate equipment/system within sixteen hours after the four hour trouble shooting time and restore operation of effected location to system performance standards.
  - 6. Replace any sub-system or major system that cannot be corrected within one working day, with compatible temporary equipment returning system or sub-system to full operational capability, until repairs are complete.

**END OF SECTION**

**SECTION 275223  
NURSE CALL AND CODE BLUE SYSTEMS**

**PART 1 - GENERAL**

**1.01 SECTION SUMMARY**

- A. Work covered by this document includes design, engineering, labor, material and products, equipment warranty and system warranty, training and services for, and incidental to, the complete installation of new and fully operating National Fire Protection Association (NFPA) – Life Safety Code 101.3-2 (a) Labeled and (b) Listed, Emergency Service Nurse-Call and/or Life Safety listed Code Blue Communication System and associated equipment (hereinafter referred to as the System) provided in approved locations indicated on the contract drawings. These items shall be tested and certified capable of receiving, distributing, interconnecting and supporting Nurse-Call and/or Code Blue communications signals generated local and remotely as detailed herein.
- B. Work shall be complete, Occupational Safety and Health Administration (OSHA), National Recognized Testing Laboratory (NRTL – i.e. Underwriters Laboratory [UL]) Listed and Labeled; and VA Central Office (VACO), Telecommunications Voice Engineering (TVE 005OP3B) tested, certified and ready for operation.
- C. The System shall be delivered free of engineering, manufacturing, installation, and functional defects. It shall be designed, engineered and installed for ease of operation, maintenance, and testing.
- D. The term “provide”, as used herein, shall be defined as: designed, engineered, furnished, installed, certified, tested, and warranty by the Contractor.
- E. Specification Order of Precedence: In the event of a conflict between the text of this document and the Project’s Contract Drawings outlined and/or cited herein; THE TEXT OF THIS DOCUMENT TAKES PRECEDENCE. HOWEVER, NOTHING IN THIS DOCUMENT WILL SUPERSEDE APPLICABLE EMERGENCY LAWS AND REGULATIONS, SPECIFICALLY NATIONAL AND/OR LOCAL LIFE AND PUBLIC SAFETY CODES. The Local Fire Marshall and/or VA Public Safety Officer are the only authorities that may modify this document’s EMERGENCY CODE COMPLIANCE REQUIREMENTS, on a case by case basis, in writing and confirmed by VA’s Project Manager (PM), Resident Engineer (RE) and TVE-005OP3B. The VA PM is the only approving authority for other amendments to this document that may be granted, on a case by case basis, in writing with technical concurrences by VA’s PM, RE, TVE-005OP3B and identified Facility Project Personnel.
- F. The Original Equipment Manufacturer (OEM) and Contractor shall ensure that all management, sales, engineering and installation personnel have read and understand the requirements of this specification before the system is designed, engineered, delivered and provided. The Contractor shall furnish a written statement stating this requirement as a part of the technical submittal that includes each name and certification, including the OEMs. The Contractor is cautioned to obtain in writing, all approvals for system changes relating to the published contract specifications and drawings, from the PM and/or the RE before proceeding with the change.

**1.02 RELATED SECTIONS**

- A. 01 33 23 – Shop Drawings, Product Data and Samples.
- B. 07 84 00 – Firestopping.
- C. 27 05 11 – Requirements for Communications Installations.
- D. 27 05 26 – Grounding and Bonding for Communications Systems.
- E. 27 05 33 – Raceways and Boxes for Communications Systems.
- F. 27 10 00 – CONTROL, COMMUNICATION AND SIGNAL WIRING.

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- G. 27 11 00 – Telecommunications Room Fittings.
- H. 27 15 00 – Communications Structured Cabling.
- I. 27 41 31 – Master Antenna Television Equipment and Systems
- J. 27 51 16 – Public Address & Mass Notification System (PA).
- K. 10 25 13 – Patient Bed Service Walls.

**1.03 DEFINITION**

- A. Provide: Design, engineer, furnish, install, connect complete, test, certify and warranty.
- B. Work: Materials furnished and completely installed.
- C. Review of contract drawings: A service by the engineer to reduce the possibility of materials being ordered which do not comply with contract documents. The engineer's review shall not relieve the Contractor of responsibility for dimensions or compliance with the contract documents. The reviewer's failure to detect an error does not constitute permission for the Contractor to proceed in error.
- D. Headquarters (aka VACO) Technical Review, for National and VA Communications and Security, Codes, Frequency Licensing Standards, Guidelines and Compliance:
  - 1. Office of Telecommunications
  - 2. Special Communications Team (07A2)
  - 3. 202-461-5301, 202-461-5311
- E. Engineer: // XXXXXXXX //
  - 1. // XXXXXXXX //
  - 2. // XXXXXXXX //
  - 3. // XXXXXXXX //
  - 4. // XXXXXXXX //
- F. Owner: // XXXXXXXX //
- G. General Contractor (GC): // XXXXXXXX //
- H. Contractor: Systems Contractor; you; successful bidder.

**1.04 REFERENCES**

- A. The installation shall comply fully with all governing authorities, laws and ordinances, regulations, codes and standards, including, but not limited to:
  - 1. United States Federal Law:
    - a. Departments of:
      - 1) Commerce, Consolidated Federal Regulations (CFR), Title 15 – Under the Information Technology Management Reform Act (Public Law 104-106), the Secretary of Commerce approves standards and guidelines that are developed by the:
        - (a) Chapter II, National Institute of Standards Technology (NIST – formerly the National Bureau of Standards). Under Section 5131 of the Information Technology Management Reform Act of 1996 and the Federal Information Security Management Act of 2002 (Public Law 107-347), NIST develops – Federal Information Processing Standards Publication (FIPS) 140-2—Security Requirements for Cryptographic Modules.
        - (b) Chapter XXIII, National Telecommunications and Information Administration (NTIA – aka 'Red Book') Chapter 7.8 / 9; CFR, Title 47 Federal communications Commission (FCC) Part 15, Radio Frequency Restriction of Use and Compliance in "Safety of Life" Functions & Locations.
      - 2) FCC - Communications Act of 1934, as amended, CFR, Title 47 – Telecommunications, in addition to Part 15 – Restrictions of use for Part 15 listed Radio Equipment in Safety of Life / Emergency Functions / Equipment/

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Locations (also see CFR, Title 15 – Department of Commerce, Chapter XXIII – NTIA):

- (a) Part 15 – Restrictions of use for Part 15 listed Radio Equipment in Safety of Life / Emergency Functions / Equipment/Locations.
  - (b) Part 58 – Television Broadcast Service.
  - (c) Part 90 – Rules and Regulations, Appendix C.
- 3) Health, (Public Law 96-88), CFR, Title 42, Chapter IV Health & Human Services, CFR, Title 46, Subpart 1395(a)(b) JCAHO “a hospital that meets JCAHO accreditation is deemed to meet the Medicare conditions of Participation by meeting Federal Directives:”
- (a) All guidelines for Life, Personal and Public Safety; and, Essential and Emergency Communications.
- 4) Labor, CFR, Title 29, Part 1910, Chapter XVII - Occupational Safety and Health Administration (OSHA), Occupational Safety and Health Standard:
- (a) Subpart 7 - Definition and requirements (for a NRTL – 15 Laboratory’s, for complete list, contact ([http://www.osha.gov/dts/otpca/nrtl/faq\\_nrtl.html](http://www.osha.gov/dts/otpca/nrtl/faq_nrtl.html)):
    - (1) UL:
      - 44-02 – Standard for Thermoset-Insulated Wires and Cables.
      - 65 – Standard for Wired Cabinets.
      - 83-03 – Standard for Thermoplastic-Insulated Wires and Cables
      - 467-01 – Standard for Electrical Grounding and Bonding Equipment
      - 468 – Standard for Grounding and Bonding Equipment.
      - 486A-01 – Standard for Wire Connectors and Soldering Lugs for Use with Copper Conductors
      - 486C-02 – Standard for Splicing Wire Connectors.
      - 486D-02 – Standard for Insulated Wire Connector Systems for Underground Use of in Damp or Wet Locations
      - 486E-00 – Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors.
      - 493-01 – Standard for Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable.
      - 514B-02 – Standard for Fittings for Cable and Conduit.
      - 1069 – Hospital Signaling and Nurse Call Equipment.
      - 1449 – Standard for Transient Voltage Surge Suppressors.
      - 1479-03 – Standard for Fire Tests of Through-Penetration Fire Stops.
      - 1666 – Standard for Wire/Cable Vertical (Riser) Tray Flame Tests.
      - 1863 – Standard for Safety, Communications Circuits Accessories.
      - 2024 – Standard for Optical Fiber Raceways.
      - 60950-1/2 – Information Technology Equipment – Safety
    - (2) Canadian Standards Association (CSA): same tests as for UL.
    - (3) Communications Certifications Laboratory (CCL): same tests as for UL.
    - (4) Intertek Testing Services NA, Inc. (ITSNA formerly Edison Testing Laboratory (ETL): same tests as for UL.
  - (b) Subpart 35 – Compliance with NFPA 101 – Life Safety Code.
  - (c) Subpart 36 - Design and construction requirements for exit routes.
  - (d) Subpart 268 - Telecommunications.
  - (e) Subpart 305 - Wiring methods, components, and equipment for general use.
- 5) Department of Transportation, CFR, Title 49 (Public Law 89-670), Part 1, Subpart C – Federal Aviation Administration (FAA):
- (a) Standards AC 110/460-ID & AC 707 / 460-2E – Advisory
  - (b) Circulars for Construction of Antenna Towers.

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- (c) Forms 7450 and 7460-2 – Antenna Construction Registration.
- 6) Veterans Affairs (Public Law No. 100-527), CFR, Title 38, Volumes I & II:
  - (a) Office of Telecommunications:
    - (1) Handbook 6100 – Telecommunications.  
Spectrum Management FCC & NTIA Radio Frequency Compliance and Licensing program.  
Special Communications Proof of Performance Testing, VACO Compliance and Life Safety Certification (s).
  - (b) Office of Cyber and Information Security (OCIS):
    - (1) Handbook 6500 - Information Security Program.
    - (2) Wireless and Handheld Device Security Guideline Version, August 15, 2005.
  - (c) VA's National Center for Patient Safety – Veterans Health Administration Warning System, Failure of Medical Alarm Systems using Paging Technology to Notify Clinical Staff, July 2004.
  - (d) VA's Center for Engineering Occupational Safety and Health, concurrence with warning identified in VA Directive 7700.
  - (e) Office of Construction and Facilities Management (CFM):
    - (1) Master Construction Specifications (PG-18-1).
    - (2) Standard Detail and CAD Standards (PG-18-4).
    - (3) Equipment Guide List (PG-18-5).
    - (4) Electrical Design Manual for VA Facilities (PG 18-10), Articles 7 & 8
    - (5) Minimum Requirements of A/E Submissions (PG 18-15):  
Volume B, Major New Facilities, Major Additions; and Major Renovations, Article VI, Paragraph B.  
Volume C - Minor and NRM Projects, Article III, Paragraph S.  
Volume E - Request for Proposals Design/Build Projects, Article II, Paragraph F.
    - (6) Mission Critical Facilities Design Manual (Final Draft – 2007)
    - (7) Life Safety Protected Design Manual (Final Draft – 2007)
    - (8) Solicitation for Offerors (SFO) for Lease Based Clinics - (05-2009)
- b. Federal Specifications (Fed. Specs.):
  - 1) A-A-59544-00 - Cable and Wire, Electrical (Power, Fixed Installation).
- 2. National Codes:
  - a. American Institute of Architects (AIA): Guidelines for Healthcare Facilities.
  - b. American National Standards Institute/Electronic Industries Association/Telecommunications Industry Association (ANSI/EIA/TIA):
    - 1) 568-B - Commercial Building Telecommunications Wiring Standards:
      - (a) B-1 – General Requirements.
      - (b) B-2 – Balanced twisted-pair cable systems.
      - (c) B-3 - Fiber optic cable systems.
    - 2) 569 - Commercial Building Standard for Telecommunications Pathways and Spaces.
    - 3) 606 – Administration Standard for the Telecommunications Infrastructure of Communications Buildings.
    - 4) 607 – Commercial Building Grounding and Bonding Requirements for Telecommunications.
    - 5) REC 127-49 – Power Supplies.
    - 6) RS 270 – Tools, Crimping, Solderless Wiring Devices, Recommended Procedures for User Certification.
  - c. American Society of Mechanical Engineers (ASME):
    - 1) Standard 17.4 – Guide for Emergency Personnel.

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- d. American Society of Testing Material (ASTM):
  - 1) D2301-04 - Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape.
- e. Building Industries Communications Services Installation (BICSI):
  - 1) All standards for smart building wiring, connections and devices for commercial and medical facilities.
  - 2) Structured Building Cable Topologies.
  - 3) In consort with ANSI/EIA/TIA.
- f. Institute of Electrical and Electronics Engineers (IEEE):
  - 1) SO/TR 21730:2007 - Use of mobile wireless communication and computing technology in healthcare facilities - Recommendations for electromagnetic compatibility (management of unintentional electromagnetic interference) with medical devices.
  - 2) 0739-5175/08/©2008 IEEE – Medical Grade – Mission Critical – Wireless Networks.
  - 3) C62.41 – Surge Voltages in Low-Voltage AC Power Circuits.
- g. NFPA:
  - 1) 70 - National Electrical Code (current date of issue) – Articles 517, 645 & 800.
  - 2) 75 - Standard for Protection of Electronic Computer Data-Processing Equipment.
  - 3) 77 – Recommended Practice on Static Electricity.
  - 4) 99 - Healthcare Facilities.
  - 5) 101 - Life Safety Code.
- 3. State Hospital Code(s).
- 4. Local Town, City and/or County Codes.
- 5. Accreditation Organization(s):
  - a. Joint Commission on Accreditation of Hospitals Organization (JCAHO) – Section VI, Part 3a – Operating Features.

### 1.05 QUALIFICATIONS

- A. The OEM shall have had experience with three (3) or more installations of Nurse Call systems of comparable size and interfacing complexity with regards to type and design as specified herein. Each of these installations shall have performed satisfactorily for at least one (1) year after final acceptance by the user. Include the names, locations and point of contact for these installations as a part of the submittal.
- B. The Contractor shall submit certified documentation that they have been an authorized distributor and service organization for the OEM for a minimum of three (3) years. The Contractor shall be authorized by the OEM to pass thru the OEM's warranty of the installed equipment to VA. In addition, the OEM and Contractor shall accept complete responsibility for the design, installation, certification, operation, and physical support for the System. This documentation, along with the System Contractor and OEM certifications must be provided in writing as part of the Contractor's Technical submittal.
- C. The Contractor's Communications Technicians assigned to the System shall be fully trained, qualified, and certified by the OEM on the engineering, installation, operation, and testing of the System. The Contractor shall provide formal written evidence of current OEM certification(s) for the installer(s) as a part of the submittal or to the RE before being allowed to commence work on the System.
- D. The Contractor shall display all applicable national, state and local licenses.
- E. The Contractor shall submit copy (s) of Certificate of successful completion of OEM's installation/training school for installing technicians of the System's Nurse Call and/or Code Blue equipment being proposed.

#### **1.06 CODES AND PERMITS**

- A. Provide all necessary permits and schedule all inspections as identified in the contract's milestone chart, so that the system is proof of performance tested, certified and approved by VA and ready for operation on a date directed by the Owner.
- B. The contractor is responsible to adhere to all codes described herein and associated contractual, state and local codes.

#### **1.07 SCHEDULING**

- A. After the award of contract, the Contractor shall prepare a detailed schedule (aka milestone chart) using "Microsoft Project" software or equivalent. The Contractor Project Schedule (CPS) shall indicate detailed activities for the projected life of the project. The CPS shall consist of detailed activities and their restraining relationships. It will also detail manpower usage throughout the project.
- B. It is the responsibility of the Contractor to coordinate all work with the other trades for scheduling, rough-in, and finishing all work specified. The owner will not be liable for any additional costs due to missed dates or poor coordination of the supplying contractor with other trades.

#### **1.08 REVIEW OF CONTRACT DRAWINGS AND EQUIPMENT DATA SUBMITTALS (AKA TECHNICAL SUBMITTAL[S])**

(Note: The Contractor is encouraged, but not required, to submit separate technical submittal(s) outlining alternate technical approach(s) to the system requirements stated here-in as long as each alternate technical document(s) is complete, separate, and submitted in precisely the same manner as outlined herein. VA will review and rate each received alternate submittal, which follows this requirement, in exactly the same procedure as outlined herein. Partial, add-on, or addenda type alternates will not be accepted or reviewed.)

- A. Submit at one time within 10 days of contract awarding, drawings and product data on all proposed equipment and system. Check for compliance with contract documents and certify compliance with Contractor's "APPROVED" stamp and signature.
- B. Support all submittals with descriptive materials, i.e., catalog sheets, product data sheets, diagrams, and charts published by the manufacturer. These materials shall show conformance to specification and drawing requirements.
- C. Where multiple products are listed on a single cut-sheet, circle or highlight the one that you propose to use. Provide a complete and through equipment list of equipment expected to be installed in the system, with spares, as a part of the submittal. Special Communications (TVE-005OP3B) will not review any submittal that does not have this list.
- D. Provide four (4) copies to the PM for technical review. The PM will provide a copy to the offices identified in Paragraph 1.3.C & D, at a minimum for compliance review as described herein where each responsible individual(s) shall respond to the PM within 10 days of receipt of their acceptance or rejection of the submittal(s).
- E. Provide interconnection methods, conduit (where not already installed), junction boxes (J-Boxes), cable, interface fixtures and equipment lists for the: ENR(s) ( aka DMARC), TER, TCR, MCR, MCOR, PCR, ECR, Stacked Telecommunications Rooms (STR), Nurses Stations (NS), Head End Room (HER), Head End Cabinet (HEC), Head End Interface Cabinet (HEIC) and approved TCO locations TIP interface distribution layout drawing, as they are to be installed and interconnected to each other.
- F. Equipment technical literature detailing the electrical and technical characteristics of each item of equipment to be furnished.
- G. Engineering drawings of the System, showing calculated of expected signal levels at the headend input and output, each input and output distribution point, and signal level at each telecommunications outlet.

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H. Surveys Required as a Part of The Technical Submittal:

1. The Contractor shall provide the following System surveys that depict various system features and capacities required in addition to the on-site survey requirements described herein (see Specification Paragraph 2.4.3). Each survey shall be in writing and contain the following information (the formats are suggestions and may be used for the initial Technical Submittal Survey requirements), as a minimum:

a. Nurse Call Cable System Design Plan:

- 1) An OEM and contractor designed functioning Nurse Call System cable plan to populate the entire TIP empty conduit/pathway distribution systems provided as a part of Specification 27 11 00 shall be provided as a part of the technical proposal. A specific functioning Nurse Call: cable, interfaces, J-boxes and back boxes shall coincide with the total growth items as described herein. It is the Contractor's responsibility to provide the Systems' entire Nurse Call cable and accessory requirements and engineer a functioning Nurse Call distribution system and equipment requirement plan of the following paragraph(s), at a minimum:
- 2) The required Nurse Call and/or Code Blue Equipment Locations:

EQUIPPED ITEM	CAPACITY	GROWTH
Master Stations		
Dome Lights		
Room		
Corridor		
Other		
Patient Stations		
Single		
Dual		
Isolation		
Other		
Emergency Stations		
Bath		
Toilet		
Isolation		
Other		
Staff Stations		
Duty Stations		
Code Blue		
Patient Locations		
Surgical Recovery Locations		
Medical Recovery Locations		
ICU Locations		
SICU		
MICU		
CCU		
Other		
Emergency Room		



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Locations		
Other		
Supervisory Locations		
Nurse Stations		
On-Call Rooms		
Other		
Remote Locations		
Telephone Operator's Room		
Police Control Room		
Other		
Radio Paging Access (when pre-approved by TVE-005OP3B)		
Audio Paging Access (when pre-approved by TVE-005OP3B)		
Wireless Access (when pre-approved by TVE-005OP3B)		
Maintenance/Programming Console		
Location(s)		
Central Control Cabinet/Equipment		
Location		
Power Supply(s)		
UPS(s)		

- 3) The required Nurse Call and/or Code Blue Cable Plant/Connections:  
 The Contractor shall clearly and fully indicate this category for each item identified herein as a part of the technical submittal. For this purpose, the following definitions and sample connections are provided to detail the system's capability:

<b>EQUIPPED ITEM</b>	<b>CAPACITY</b>	<b>GROWTH</b>
Central Control Cabinet/Equipment		
Location		
Power Supply(s)		
UPS(s)		
Essential Electrical Power Panel(s)		
Other		
Cable Plant		
Supply to Locations Identified in Paragraph		

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1.8.H.1.a.2)		
Remote Locations		
Telephone Operator Room		
Police Control Room		
Other		
Maintenance/Program Console		
Location(s)		
Other		
LAN (Local Facility) Access/Equipment/Location (when pre-approved by TVE-005OP3B)		
Wireless Access/Equipment/Location (when pre-approved by TVE-005OP3B)		
PA Access/Equipment/Location (when pre-approved by TVE-005OP3B)		
Other		

**1.09 PROJECT RECORD DOCUMENTS (AS BUILTS)**

- A. Throughout progress of the Work, maintain an accurate record of changes in Contract Documents. Upon completion of Work, transfer recorded changes to a set of Project Record Documents.
- B. The floorplans shall be marked in pen to include the following:
  - 1. Each device specific locations with UL labels affixed.
  - 2. Conduit locations.
  - 3. Each interface and equipment specific location.
  - 4. Head-end equipment and specific location.
  - 5. Wiring diagram.
  - 6. Labeling and administration documentation.
  - 7. Warranty certificate.
  - 8. System test results.

**1.10 WARRANTIES / GUARANTY**

- A. The Contractor shall warrant the installation to be free from defect in material and workmanship for a period of two (2) years from the date of acceptance of the project by the owner. The Contractor shall agree to remedy covered defects within four (4) hours of notification of major failures or within twenty-four (24) hours of notification for individual station related problems.
- B. The Contractor shall agree to grantee the system according to the guidelines outlined in Article 4 herein.

**1.11 USE OF THE SITE**

- A. Use of the site shall be at the GC's direction.
- B. Coordinate with the GC for lay-down areas for product storage and administration areas.
- C. Coordinate work with the GC and their sub-contractors.

D. Access to buildings wherein the work is performed shall be directed by the GC.

#### 1.12 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft.
- B. Store products in original containers.
- C. Coordinate with the GC for product storage. There may be little or no storage space available on site. Plan to potentially store materials off site.
- D. Do not install damaged products. Remove damaged products from the site and replaced with new product at no cost to the Owner.

#### 1.13 PROJECT CLOSE-OUT

- A. Prior to final inspection and acceptance of the work, remove all debris, rubbish, waste material, tools, construction equipment, machinery and surplus materials from the project site and thoroughly clean your work area.
- B. Before the project closeout date, the Contractor shall submit:
  - 1. OEM Equipment Warranty Certificates.
  - 2. Evidence of compliance with requirements of governing authorities such as the Low Voltage Certificate of Inspection.
  - 3. Project record documents.
  - 4. Instruction manuals and software that is a part of the system.
  - 5. System Guaranty Certificate.
- C. Contractor shall submit written notice that:
  - 1. Contract Documents have been reviewed.
  - 2. Project has been inspected for compliance with contract.
  - 3. Work has been completed in accordance with the contract.

### PART 2 – PRODUCTS / FUNCTIONAL REQUIREMENTS

#### 2.01 GENERAL REQUIREMENTS FOR EQUIPMENT AND MATERIALS

- A. Furnish and install a complete and fully functional and operable Nurse Call System for each location shown on the contract drawings and TCOs WHOSE EMPTY CONDUIT SYSTEM WAS PROVIDED AS A PART OF SPECIFICATION 27 11 00.
- B. The specific location for each Nurse Call: Central Control Cabinet is // \_\_\_\_\_, // Power Supply is // \_\_\_\_\_, // Electrical Supervisor Panel is // \_\_\_\_\_, // UPS is // \_\_\_\_\_, // Two (2) Remote Annunciation Consoles is // \_\_\_\_\_, // Master Station is // \_\_\_\_\_, // Duty Station is // \_\_\_\_\_, // Staff Station is // \_\_\_\_\_, // Emergency Station is // \_\_\_\_\_, // Dome Light is // \_\_\_\_\_, // Code Blue Station is // \_\_\_\_\_, // and TCOs are // \_\_\_\_\_ (list locations here AND indicate like locations on the contract drawings) //.
- C. Coordinate features and select interface components to form an integrated Nurse Call system. Match components and interconnections between the systems for optimum performance of specified functions.
- D. Expansion Capability: The Nurse Call equipment interfaces and cables shall be able to increase number of enunciation points in the future by a minimum of 50 percent (%) above those indicated without adding any internal or external components or main trunk cable conductors.
- E. Equipment: Active electronic type shall use solid-state components, fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied between 110 to 130 VAC, 60 Hz supplied from the Facility's Emergency Electrical Power System.

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- F. Meet all FCC requirements regarding equipment listing, low radiation and/or interference of RF signal(s). The system shall be designed to prevent direct pickup of signals from within and outside the building structure.
- G. Weather/Water Proof Equipment: Listed and labeled by an OSHA certified NRTL (i.e. UL) for duty outdoors or in damp locations.

**2.02 SYSTEM DESCRIPTION**

- A. Furnish and install a complete and fully functional and operable Nurse Call and/or Code Blue System WHOSE EMPTY CONDUIT SYSTEM WAS PROVIDED AS A PART OF SPECIFICATION 27 11 00.
- B. The Contractor is responsible for interfacing the // PA // //, MATV // //, RED // //, Patient Bed Service Walls // // and \_\_\_\_\_ // systems with the System.
- C. The Contractor shall continually employ interfacing methods that are approved by the OEM and VA. At a minimum, an acceptable interfacing method requires not only a physical and mechanical connection, but also a matching of signal, voltage, and processing levels with regard to signal quality and impedance. The interface point must adhere to all standards described herein for the full separation of Critical Care and Life Safety systems.
- D. The System Contractor shall connect the System ensuring that all NFPA and UL Critical Care and Life Safety Circuit and System separation guidelines are satisfied. The System Contractor is not allowed to make any connections to the Telephone System. VA shall arrange for the interconnection between the // PA // //, MATV // //, RED // //, Patient Bed Service Walls // // and \_\_\_\_\_ // Systems with the appropriate responsible parties.
- E. System hardware shall consist of a standalone (separate) nurse call // Code Blue // patient communications network comprised of nurse consoles, control stations, staff and duty stations, room and corridor dome lights, pillow speakers/call cords, pull cord and/or emergency push button stations, wiring. Also, other options such as pocket page interfaces, computer interfaces, printer interfaces, wireless / telephone network interfaces, and nurse locating system interface (when specifically approved first by TVE 005OP3B) and as shown on drawings. All necessary equipment required to meet the intent of these specifications, whether or not enumerated within these specifications, shall be supplied and installed to provide a complete and operating nurse call // Code Blue // patient communications network. It is not acceptable to utilize the telephone cable system for the control and distribution of nurse call (code Blue) signals and equipment.
- F. System firmware shall be the product of a reputable firmware OEM of record with a proven history of product reliability and sole control over all source code. Manufacturer shall provide, free of charge, product firmware/software upgrades for a period of two (2) years from date of acceptance by VA for any product feature enhancements. System configuration programming changes shall not require any exchange of parts and shall be capable of being executed remotely via a modem connection (when specifically approved first by TVE 005OP3B).
- G. The Nurse Call Head End Equipment shall be located in Telecommunications Room // \_\_\_\_\_ //. The Nurse Call / Code Blue System may interface the PA system when specifically approved by VA Headquarters TVE 005OP3B during the project approval process prior to contract bidding.
- H. The System shall utilize microprocessor components for all signaling and programming circuits and functions. Selfcontained or onboard system program memory shall be non-volatile and protected from erasure from power outages for a minimum of 12 hours.
- I. Provide a backup battery or a UPS for the System (including each distribution cabinet/point, CRT and Monitor) to allow normal operation and function (as if there was no AC power failure) in the event of an AC power failure or during input power fluctuations for a minimum of 30 minutes.

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- J. The System is defined as Critical Service and the Code Blue functions is defined as Life Safety/Support by NFPA (re Part 1.1.A) and so evaluated by JCAHCO. Therefore, the system shall have a minimum of two (2) additional remote enunciation points in order to satisfy NFPA's Life Safety Code 101 (the typical secondary locations are Telephone Operators Room, MAS ER Desk, Boiler Plant, etc.; AND the primary location is required to be in the SCC Room.
1. These two (2) additional remote locations shall be fully manned:
    - a. 24/7/365 for certified Clinics.
    - b. As long as other identified VA Medical / Servicing Facilities are open for servicing patients.
    - c. At a minimum, Code Blue Functions shall be provided in all Recovery (Medical and Surgical) Rooms, Intensive Care Units (ICU), Cardiac Care Units (CCU), Step Down Room, Life Support / Monitoring Rooms, Oncology / Radiology Procedure Rooms, Dialysis // and \_\_\_\_\_ // Areas.
    - d. The minimum remote enunciation locations shall be:
      - 1) The Telephone / PBX Operator Room.
      - 2) The Police Control / Operations Room.
      - 3) Other location(s) that is specifically approved by VA Headquarters TVE - 005OP3B DURING THE PROJECT DEVELOPMENT STAGES AND PRIOR TO EQUIPMENT PURCHASE.
  2. In addition to the two (2) remote locations afore described, the following locations are the minimum required for additional Nurse Call /Code Blue Annunciation:
    - a. "On Call" Rooms.
    - b. Each Nurse Master Station.
    - c. Each Staff Station.
    - d. Each Duty Station.
  3. The MAXIMUM enunciation time period from placement of the Code Blue Call to enunciation at each remote locations is 10 seconds; and, 15 seconds to the subsequent enunciating media stations (i.e. PA, Radio Paging, Emergency Telephone or Radio Backup, etc.).
- K. Each Code Blue System shall be designed to provide continuous electrical supervision of the complete and entire system (i.e. dome light bulbs [each light will be considered supervised if they use any one or a combination of (UL) approved electrical supervision alternates, as identified in UL-1069, 1992 revision], wires, contact switch connections, circuit boards, data, audio, and communication busses, main and UPS power, etc.). All alarm initiating and signaling circuits shall be supervised for open circuits, short circuits, and system grounds. Main and UPS power circuits shall be supervised for a change in state (i.e. primary to backup, low battery, UPS on line, etc.). When an open, short or ground occurs in any system circuit, an audible and visual fault alarm signal shall be initiated at the nurse control station and all remote locations.
- L. When the System is approved to connect to a separate communications system (i.e. LAN, WAN, Telephone, Public Address, radio raging, wireless systems, etc.) the connection point shall meet the following minimum requirements for each hard wired / wireless connection (note each wireless system connection MUST BE APPROVED PRIOR TO CONTRACT BID BY VA HEADQUARTERS TVE - 005OP3B AND SPECTRUM MANAGEMENT - 005OP2B – hereinafter referred to as SM - 005OP2B):
1. UL 60950-1/2.
  2. FIPS 142.
  3. FCC Part 15 Listed Radio Equipment restriction compliance approved by SM – 005OP2B.
- M. All passive distribution equipment shall meet or exceed -80 dB radiation shielding (aka RFI) shielding specifications and be provided with connectors specified by the OEM.
- N. All equipment face plates utilized in the system shall be stainless steel, anodized aluminum or UL approved cyclocac plastic for the areas where provided.

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- O. Noise filters and surge protectors shall be provided for each equipment interface cabinet, headend cabinet, control console and local and remote amplifier locations to insure protection from input primary AC power surges and to insure noise glitches are not induced into low voltage data circuits.
- P. Plug-in connectors shall be provided to connect all equipment, except coaxial cables. Coaxial cable distribution points shall use coaxial cable connections recommended by the cable OEM and approved by the system OEM. Base band cable systems shall utilize barrier terminal screw type connectors, at a minimum. As an alternate, crimp type connectors installed with a ratchet type installation tool are acceptable provided the cable dress, pairs, shielding, grounding, connections and labeling are the same as the barrier terminal strip connectors. Tape of any type, wire nuts or solder type connections are unacceptable and will not be approved.
- Q. Audio Level Processing: The control equipment shall consist of audio mixer(s), volume limiter(s) and/or compressor(s), and power amplifier(s) to process, adjust, equalize, isolate, filter, and amplify each audio channel for each sub-zone in the system and distribute them into the System's RF interfacing distribution trunks and amplification circuits. It is acceptable to use identified Telephone System cable pairs designated for Two-Way Radio interface and control use or identified as spare telephone cable pairs by the Facility's Telephone System Contractor. The use of telephone cable to distribute RF signals, carrying system or sub-system AC or DC voltage is not acceptable and will not be approved. Additionally, each control location shall be provided with the equipment required to insure the system can produce its designed audio channel capacity at each speaker identified on the contract drawings. The Contractor shall provide: a spare set of telephone paging modules as recommended by the OEM (as a minimum provide one spare module for each installed module); one spare audio power amplifier, one spare audio mixer, one spare audio volume limiter and/or compressor, and one spare audio automatic gain adjusting device, and minimum RF equipment recommended by the OEM.
- R. Contractor is responsible for pricing all accessories and miscellaneous equipment required to form a complete and operating system. Unless otherwise noted in this Part, equipment quantities shall be as indicated on the drawings.
- S. System Performance:
  - 1. At a minimum, each distribution, interconnection, interface, terminating point and TCO shall be capable of supporting the Facility's Nurse Call and/or Code Blue System voice and data service as follows:
    - a. Shall be compliant with and not degrade the operating parameters of the Public Switched Telephone Network (PSTN) and the Federal Telecommunications System (FTS) at each PSTN and FTS interface (if attachment is permitted by TVE 005OP3B), interconnection and TCO terminating locations detailed on the contract drawings.
    - b. The System shall provide the following minimum operational functions:
      - 1) Code Blue calls shall be cancelable at the calling station only. The nurse call master station (s) that a managing Code Blue functions shall not have the ability to cancel Code Blue calls.
      - 2) Each Code Blue system shall be able to receive audio calls from all bedside stations simultaneously.
      - 3) Calls placed from any Code Blue station shall generate Code Blue emergency type audible and visual signals at each associated nurse control and duty station, respective dome lights and all local and remote annunciator panels. Calls placed from a bedside station shall generate emergency type visual signals at the bedside station and associated dome light(s) in addition to the previous stated stations and panels.
      - 4) Activating the silencing device at any location, while a Code Blue call or system fault is occurring shall mute the audible signals at the alarm location.
        - (a) The audible alarm shall regenerate at the end of the selected time-out period until the call or fault is corrected.

- (b) The visual signals shall continue until the call is canceled and/or a fault is corrected. When the fault is corrected, all signals generated by the fault shall automatically cease, returning the System to a standby status.
  - (c) Audible signals shall be regenerated in any local or remote annunciator panel that is in the silence mode, in the event an additional Code Blue call is placed in any Code Blue system.
  - (d) The additional Code Blue call shall also generate visual signals at all annunciators to identify the location of the call.
2. Each System Nurse Call location shall generate a minimum of distinct calls:
- a. Routine: single flashing dome lights & master station color and audio tone,
  - b. Staff Assist: rapid flashing dome lights & master station color and audio tone,
  - c. Emergency: Red flashing dome lights & master station color and audio tone,
  - d. Code Blue (if equipped): Blue flashing dome lights and master station color and audio tone,
  - e. Each generated call shall be cancelable at ONLY the originating location,
  - f. Staff Locator: Green Flashing dome lights & master station color and audio tone, and
  - g. \_\_\_\_\_: \_\_\_\_\_ Flashing dome lights & master station color and audio tone.

### 2.03 MANUFACTURERS

- A. The products specified shall be new, FCC and UL Listed, labeled and produced by OEM manufacturer of record. An OEM of record shall be defined as a company whose main occupation is the manufacture for sale of the items of equipment supplied and which:
  - 1. Maintains a stock of replacement parts for the item submitted,
  - 2. Maintains engineering drawings, specifications, and operating manuals for the items submitted, and
  - 3. Has published and distributed descriptive literature and equipment specifications on the items of equipment submitted at least 30 days prior to the Invitation for Bid.
- B. Specifications contained herein as set forth in this document detail the salient operating and performance characteristics of equipment in order for VA to distinguish acceptable items of equipment from unacceptable items of equipment. When an item of equipment is offered or furnished for which there is a specification contained herein, the item of equipment offered or furnished shall meet or exceed the specification for that item of equipment.
- C. Equipment Standards and Testing:
  - 1. The System has been defined herein as connected to systems identified as Critical Service performing various Emergency and Life Support Functions. Therefore, at a minimum, the system shall conform to all aforementioned National and/or Local Life Safety Codes (which ever are the more stringent), NFPA, NEC, this specification, JCAHCO Life Safety Accreditation requirements, and the OEM recommendations, instructions, and guidelines.
  - 2. All supplies and materials shall be listed, labeled or certified by UL or a NRTL where such standards have been established for the supplies, materials or equipment.
  - 3. The provided equipment required by the System design and approved technical submittal must conform with each UL standard in effect for the equipment, as of the date of the technical submittal (or the date when the RE approved system equipment necessary to be replaced) was technically reviewed and approved by VA. Where a UL standard is in existence for equipment to be used in completion of this contract, the equipment must bear the approved UL seal.
  - 4. Each item of electronic equipment to be provided under this contract must bear the approved UL seal or the seal of the testing laboratory that warrants the equipment has been tested in accordance with, and conforms to the specified standards. The placement of the UL Seal shall be a permanent part of the electronic equipment that is not capable of being transportable from one equipment item to another.

## 2.04 PRODUCTS

- A. General.
1. Contractor is responsible for pricing all accessories and miscellaneous equipment required to form a complete and operating system. The equipment quantities provided herein shall be as indicated on the drawings with the exception of the indicated spare equipment.
  2. Contractor Furnished Equipment List (CFEs):
    - a. The Contractor is required to provide a list of the CFE equipment to be furnished. The quantity, make and model number of each item is required. Select the required equipment items quantities that will satisfy the needs of the system as described herein and with the OEM's concurrence applied to the list(s), in writing.
- B. NS Room(s):  
Refer to CFM Physical Security Manual (07-2007) for VA Facilities, Chapters 9.3 & 1) and PG 18-10, EDM, Chapters 7- Table 7-1, 8 & Appendix B, Telecommunications One Line Topology for specific Room and TIP Connection Requirements.
- C. TER, SCC, PCR, STR, HER Rooms and Equipment:  
Refer to CFM Physical Security Manual (07-2007) for VA Facilities, Chapters 9.3 & 1) and PG 18-10, EDM, Chapters 7- Table 7-1, 8 & Appendix B, Telecommunications One Line Topology for specific Room and TIP Connection Requirements.
- D. Telecommunications Room(s) (TR):
1. Locate the Nurse Call and/or Code Blue floor distribution equipment as required by system design and OEM direction. Provide secured and lockable cabinet/rack(s) as required.
  2. Head-End Equipment:
    - a. Provide all required power supplies, communications hubs, network switches, intelligent controllers and other devices necessary to form a complete system. Head-end components may be rack mounted or wall mounted in an enclosed metal enclosure.
    - b. Provide the head end equipment in the closest Telecommunications Room where the System is installed.
    - c. Provide the System UPS inside the cabinet or in a separate cabinet adjacent to the head end cabinet that shall maintain a minimum of 30 minute battery back-up to all system components.
    - d. Equipment Cabinet: Comply with TIA/EIA-310-D. Lockable, ventilated metal cabinet houses terminal strips, power supplies, amplifiers, system volume control, and other switching and control devices required for conversation channels and control functions. See Paragraph 2.5.E for the Cabinet's minimum internal items that are in addition to the installed System equipment.
    - e. Vertical Equipment Rack, Wall Mounted (to be included inside of the Equipment Cabinet) containing the following minimum items:
      - 1) 36-inch (28RU) internal rack space, welded steel construction, minimum 20" usable depth, adjustable front mounting rails.
      - 2) Install the following products in rack provided by same manufacturer or as specified:
        - (a) Security screws w/ nylon isolation bushings.
        - (b) Textured blank panels.
        - (c) Custom mounts for components without rack mount kits.
        - (d) Security covers.
        - (e) Internal system ground copper buss (may be substituted with a bare #0 AWG copper wire or equivalent size copper mesh strip connected to ONLY



THE FACILITY'S SIGNAL GROUNDING SYSTEM.

- (f) Power Sequencer- rack-mounted power conditioner and (provide as-needed) delayed sequencer(s) with (2) unswitched outlets each and contact closure control inputs. Connect the conditioner to one of the dual duplex outlets.
  - (g) Two (2) each 120VAC @ 20A dual duplex outlets, connected via conduit to the nearest Electrical Service Panel that is supplied by the Facility's Essential Electrical System.
  - (h) One (1) each 120VAC @ 15A Power Distribution Strip(s). Connect each strip to the unstitched outlet on the power conditioner.
3. HL7 Interface:
- a. The system may support downloading and updating of patient data from the hospital admission system (or other database) via the HL7 standard. The data only has to travel one way, i.e. from the admission system to the nurse-call system.
  - b. Coordinate with the Owner the exact fields that will be populated from the admissions system in the nurse-call system.
  - c. The Facility's LAN/WAN is not allowed for Nurses Call/Code Blue main wiring / function that must be a "stand alone primary cable infrastructure" as described herein.
  - d. Connections to the VA LAN/WAN for functional or operable conditions will be allowed ONLY when the LAN/WAN system has been demonstrated and NFPA (at a minimum by TVE-005OP3B) Certified meeting Life Safety Standards.
  - e. Provide one (1) spare HL Interface unit.
4. Wireless:
- a. Radio Paging Equipment / Systems
    - 1) The nurse call/code blue system shall have the ability to interface ONLY with VA Certified and Licensed radio paging system (FCC Part 15 listed pagers and transmitters are not allowed for "Safety of Life" functions or installed in those specific areas – VA Headquarters TVE - 005OPB2 and SM - 005OPB2 are the ONLY approving authorities for this function) and must have the following minimum system features:
      - (a) Ability to pass-through location information (such as a room number) and call-type as well as other text messages simultaneously to shift supervisor identified staff members
      - (b) System shall allow the operator to select staff members by name and pager number and to select a message consisting of a room number and a condition code (aka priority level). Operator may also choose to type in a unique alpha-numeric text message (the text message shall meet or exceed all HIPA and VA OCIS Communications Security Guidelines for the transmission of Patient or Staff Specific information [aka PII] – VA Headquarters TVE - 005OP2B is the approving authority for this function) into the system to be read by the holder of the pager unit.
      - (c) While a patient station is connected to the nurse's master station, the system shall allow the operator to automatically page the staff member assigned to that room. An alternate staff member may be selected for paging purposes in place of the primary staff member. The System must allow an alternate staff member to be paged when the primary staff member is unable to respond to patient's needs within a specified period of time. The System must have the ability to assign any bed to any pager or pager group, and to assign an unlimited amount of pagers to any patient bed.
      - (d) System shall have the ability to send all code blue calls to staff members by predetermined group (as required) automatically by simply pressing one "Code Blue" button. Pager shall indicate room number of code call, and

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state "Code Blue" in plain English format on pagers (FCC Part 15 listed pagers are not allowed to be use as "Safety of Life" functions or those specific locations – VA Headquarters TVE - 005OP2B is the approving authority for this requirement).

- 2) When pagers are approved, provide a minimum of ten (10) spare pagers with one spare pager for each 10 issued.//
5. Personal Wireless Communicator
  - a. The System will only be allowed to connect to the personal wireless communications system, pass text data and provide a 2-way communication between the Telephone Interface and the personal wireless communicator as long as it is not a FCC Part 15 listed device(s), meets or exceeds UL 60950-1/2, meets OCIS Guide Lines for FIPS 140-2 certification and the using staff shows an extensive training program along with recertification(s) according to the Facility Emergency Plan concerning HIPA requirements.
  - b. VA Headquarters TVE - 005OP3B and SM - 005OP2B are the approving authority for this requirement.
  - c. When communicators are approved, provide a minimum of ten (10) spare communicators for each 10 communicators issued.//
6. Other Wireless Equipment / Systems
  - a. Each proposed wireless system and/or equipment to be connected to or be a part of the System, each shall meet the minimum requirements outlines in Paragraph 2.7.A.
  - b. Contact TVE - 005OP3B and SM – 005OP2B for specific required PRE approvals (full or conditional) as described herein.
  - c. When approved, TVE-005OP3B and SM-005OP2B will provide the spare equipment requirements.
  - d. When other wireless components are approved, provide ten (10) components with one spare components for each 10 issued.
- E. TIP Cable Systems:
  1. Connect the system to the TIP system provided as a part of Speciation Section 27 15 00. Provide additional TIP equipment, interfaces and connections as required by System design. Provide secured pathway(s) and lockable cabinet/rack(s) as required.
- F. Interface Equipment:
  1. TCR:
    - a. Code Blue Annunciation Station:
      - 1) The Code Blue Remote Annunciation Station shall be located in the Telephone Operators Room, Police Control Center // or \_\_\_\_\_ //.
      - 2) The Annunciation Station shall be connected to the System via hard wire connection(s) that shall contain all the electrical supervisory tone signals, visual bulbs, read out panel to indicate the location of the Code and system troubles.
      - 3) The System shall not be connected to the Telephone system unless specifically APPROVED BY VA HEADQUARTERS (005OP3B) and (005OP2B) PRIOR TO CONTRACT BID.
      - 4) The Annunciation Station shall be installed in a location directly viewable and the readout is completely readable from the Public Address Microphone Control Console.
      - 5) Provide one (1) spare panel.
    - b. Electrical Supervision Trouble Annunciator Panel:
      - 1) The Electrical Supervision Trouble Annunciation Panel shall be located in the Telephone Operators Room, Police Control Center, associate Nurses Station(s).
      - 2) The panel(s) shall be compatible with the generated electrical and/or electronic supervising signals to continuously monitor the operating condition for the System head-end processing equipment, master stations, staff stations, patient stations, duty stations, audio power amplifier(s), UPS, power supplies, dome

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lights and interconnecting trunks. The panels shall generate an audible and visual signal when the System's supervising system detects a system and equipment trouble or trunk-line is malfunctioning.

- 3) Provide one (1) spare panel.
2. Hospital Bed Interface (s):
  - a. Provide a multi-pin receptacle for bed connection.
  - b. Connect cable from the multi-pin receptacle to the nurse-call system, so that alarms, such as bed exit, shall be monitored by the nurse-call system.
  - c. Connect cable from the multi-pin receptacle to the nurse-call system, so that the bedside control buttons, such as nurse call, and television controls are functional and monitored.
  - d. The hospital uses the following beds:
    - 1) Hill Rohm
    - 2) Stryker
    - 3) Other
  - e. Provide one (1) spare interface for each ten (10) interfaces installed.
3. Nurse (aka Staff) Locator Interface:
  - a. The System must be capable of performing nurse-locator functions.
  - b. The System must be capable of performing staff-locator functions
  - c. These functions may be combined into one operation.
  - d. Provide two (2) spare interfaces.
4. Lighting Interface Module:
  - a. Provide an interface module for the pillow speakers to control up to 2 lights. Coordinate with the electrical contractor the exact voltage requirements.
  - b. Provide one (1) spare module for each ten (10) modules installed.
5. Pillow Speaker Interfaces:
  - a. See functional requirements herein.
  - b. Provide one (1) pillow speaker for each patient station.
  - c. Provide one (1) spare pillow speaker for each twenty (20) speakers installed.
6. TV Remote Control Interface:
  - a. The pillow speaker shall have the following TV control capability:
    - 1) Play the TV audio through the pillow speaker.
    - 2) Change channels up and down.
    - 3) Increase and decrease the volume.
    - 4) TV audio mute.
    - 5) UL Certified for direct patient contact.
  - b. Provide one (1) spare interface for each 20 interfaces installed.
7. TV Control Jack and Wiring:
  - a. Provide connection from the pillow speaker to the TV location. Terminate wire on a jack in the TV low voltage faceplate. Coordinate faceplate opening with the cabling contractor. Coordinate jack type with the TV (typically it is a 1/4" jack, but verify prior to installation).
  - b. Provide patch cord from the TV control jack to the TV.
  - c. Provide one (1) spare complete assembly for each twenty (20) assemblies installed.
8. Additional Functions / Interfaces:
  - a. The nurse-call system may perform \_\_\_\_\_ additional services/ functions when specifically approved by TVE-005OP3B during the project design phases and prior to the bid process. //
9. TER
  - a. Paging adaptor (When connections are specifically approved by TVE 005OP3B):
    - 1) The Contractor shall coordinate the installation of the paging adapter(s) designed for use with the Facility's telephone system with the Facility Telephone

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- Contractor or local telephone company.
- 2) The Contractor shall provide and install a paging adapter(s) for each zone and sub zone. The paging adapter(s) shall be accessible by dialing a telephone number provided by the Facility's Telephone Contractor. The Paging Adapter shall:
    - (a) Monitor each audio input and output on the unit.
    - (b) Be provided with an electrical supervision panel to provide both audio and visual trouble alarms.
    - (c) Be provided as part of the headend equipment and shall be located in the Telephone Switch Room.
    - (d) Be provide with Executive Paging Override of all routine paging calls in progress or being accessed to allow system "all call" (aka global) and radio paging calls designated as Code One Blue) functions.
    - (e) Be capable of internal time out capability.
    - (f) Function completely with the interface module.
    - (g) Provide one spare adapter.
  - 3) Time Out Device:
    - (a) A time out device/capability shall be provided to prevent system "hang-up" due to an off-hook telephone. The device shall be able to be preset from 30 seconds to two (2) minutes. Its function shall not interfere with or override the required "all call" (aka global) operational capability.
- G. Call Initiation, Annunciation and Response:
1. Light and Tones:
    - a. Calls may be initiated through:
      - 1) Patient station.
      - 2) Staff station.
      - 3) Code Blue station.
      - 4) Toilet Emergency Station pull cord / push button.
      - 5) Shower Emergency Station pull cord.
      - 6) Bed Pillow speaker.
      - 7) Bed Push-button cordset.
      - 8) Hospital Bed Integrated controls.
    - b. Once a call is initiated, it must be annunciated at the following locations:
      - 1) The Corridor, Intersectional and Room dome light associated with the initiating device.
      - 2) A local master control station indicating the call location and priority.
      - 3) 3) Each duty station.
      - 4) Each staff station.
      - 5) Each remote location.
    - c. All calls must be displayed until they are cleared by the nursing staff ONLY from the initiating device location.
  2. Voice:
    - a. Calls may be initiated through:
      - 1) Patient station.
      - 2) Staff station.
      - 3) Code Blue station.
      - 4) Toilet Emergency pull cord / push button station.
      - 5) Shower Emergency pull cord station.
      - 6) Pillow speaker.
      - 7) Push-button cordset.
      - 8) Integrated bed controls.
      - 9) Master Station.

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3. Provide two-way voice communication between a master station and patient, staff, duty and each of the two (2) remote stations.
  4. Failure of voice intercom portion of system shall not interfere with visual and audible signal systems.
  5. All calls must be displayed on the master station until they are cleared by the nursing staff at ONLY the originating station. If multiple calls are received at the master station within a short period of time, they shall be stacked based on priority and wait time. If there are more calls than the master station screen can display at one time (four [4] minimum), the system must provide a simple scrolling feature. The nurse must be able to answer any call in any order at the master station. The nurse must also be able to forward calls to staff members. If a call is not answered within a programmable time period, then the system must forward the call to appropriate back-up staff identified by each shift supervisor in a manner technically approved by VA Headquarters 005OP3B.
  6. Radio pager (within the restrictions identified herein)
  7. Wireless personal communicator (within the restrictions identified herein)
- H. Auxiliary Alarm Monitoring:
1. Each patient station must have the ability to connect a separate and isolated auxiliary alarm to it such as an infusion pump or data tracking / recording device (patient life support units ARE NOT allowed to be connected to these units UNLESS APPROVED BY TVE - 005OP3B DURING THE PROJECT DEVELOPMENT PHASE AS DESCRIBED HEREIN. The System must support naming the device that is being monitored as well as display its alarms at the master station and via the room / corridor dome light(s).
  2. Provide two (2) alarm jacks at each patient station.
  3. The above requirements may ONLY be allowed when the system has been approved by VA Headquarters TVE - 005OP3B and TVE - 005OP2B and concurred by the appropriate Medical Service(s) indicates it meets the minimum guidelines and requirements of Paragraph 2.8.A.
- I. Patient and Staff Assignment:
1. System may provide for transfer of one or more individual or groups of stations from one master station to another without mechanical switches or additional wiring of the stations. The transfer may be initiated manually by the nurse or automatically at certain times of the day.
  2. The Facility's LAN/WAN IS NOT ALLOWED for Nurses Call/Code Blue main wiring which must be a "stand alone primary cable infrastructure." Connections to the VA LAN/WAN will be allowed ONLY when the LAN/WAN system has been demonstrated and certified by TVE - 005OP3B meeting the minimum guidelines and requirements of the Life Safety Code.
- J. Reports:
1. The system's generated reports logging all calls, alarms, response time, bed, and staff assignments may be allowed to transmit these reports to a central archiving entity.
  2. Reports function shall be limited by passwords and security tier level access, so that only supervisors may access it when desired.
  3. Provide instructions to the owner on how to enable/disable the reporting functions.
  4. The Facility's LAN/WAN IS NOT ALLOWED for Nurses Call/Code Blue main wiring that must be a "stand alone primary cable infrastructure." Connections to the VA LAN/WAN will be allowed ONLY when the system has been demonstrated and certified by 005OP2B meeting the minimum guidelines and requirements of the Life Safety Code.
- K. System/Management Software:
1. Provide and install system/management software on minimum of three (3) owner-provided computers.
    - a. The management software shall at a minimum provide all historical reporting features of the system as well as real-time monitoring of events.

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- b. The system software shall at a minimum provide the system's operating and functioning parameters and script. The OEM shall provide VA with access to the software's script writing and functions.
  2. Provide two (2) spare CD's with the software installed and operable.
  3. Rights in Data: VA shall have the right to all script and programming language of system management software. If commercial off the shelf (COTS) or a memorandum of understanding (MOU) is required for follow-on maintenance, the Contractor is required to accomplish the COTS Survey document and the RE is required to accomplish the COTS Acquisition document supplied in Part 5 Attachments herein.
- L. System Functional Station:
1. Master Control:
    - a. Simple Tone and Light:
      - 1) A visual / aural (tone only) system shall be provided, protected and located in the Day Hospital, Mental Health & Blind Rehabilitation Areas, OPC where surgery or procedures are not performed and // \_\_\_\_\_ //. The System shall include a push-button emergency station (pull cord in Day Hospital and pushbutton in Mental Health & Blind Rehabilitation areas) with an associated corridor dome light in each dressing room (OPC) and toilet (OPC, Day Hospital, Mental Health, Blind Rehabilitation and // \_\_\_\_\_ //) and // \_\_\_\_\_ in the \_\_\_\_\_ //.
      - 2) The visual / aural (tone only) system shall also include a power supply and a visual / aural (tone only) display panel in the respective OPC receptionist / secretary's office and the Day Hospital // \_\_\_\_\_ // area and as shown on the drawings. The visual / tone display panel shall generate audible and visual emergency signals to indicate the location of a placed call.
      - 3) The Visual Display Panel shall be a digital readout touch screen to visually announce the location of incoming calls placed in the System including room and bed number and priority of the call. Identify each calling station with an individual display, including separate displays for each patient sharing a dual bedside station. If a digital readout touch screen standard is not required or approved by the Facility during the project design phase, an alpha - numeric scheme shall be provided that identifies the: ward, room and bed (i.e. Ward 2a, Room 201, Bed A (or 1) shall read 2A201A -or- 2A201-1. Equivalent readouts are acceptable as long as TVE 005OP3B and the Facility approve the readout).
        - (a) Calls placed at emergency stations located in toilets and baths inside bedrooms shall be displayed for the bed closest to the nurse control station. Beds in multi-bed bedrooms shall be identified in a clock-wise pattern upon entering the bedroom.
        - (b) It shall display a minimum of four incoming calls. Additional placed calls shall be stored in order of placement and priority.
      - 4) The visual / aural (tone only) system shall be installed according to the same Procedures, guidelines and standards outlined for a regular Nurse Call System for emergency NOT CODE BLUE OPERATION.
      - 5) Speakerphone and handset communication.
      - 6) Provide one (1) spare station for each ten (1) stations installed.
    - b. Touch Screen:
      - 1) Provide a touch screen master station with 15" minimum monitor size.
      - 2) The master station shall have a full control capability over staff assignment to patients and beds as well as pagers and wireless personal communication devices (when specifically approved by 005OP3B on a case by case basis).
      - 3) Speakerphone and handset communication.
      - 4) Provide one (1) spare station for each ten (1) stations installed.
  2. Staff:

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- a. Light and Tine Only.
  - b. Voice Communications Enabled.
  - c. Provide one (1) spare station for each twenty (20) stations installed.
3. Duty:
- a. Light and Tine Only.
  - b. Voice Communications Enabled.
  - c. Provide one (1) spare station for each twenty (20) stations installed.
4. Patient:
- a. Single & Dual:
    - 1) Provide each patient station with the following minimum
    - 2) Feature.
      - (a) Call button.
      - (b) Call answered button.
      - (c) Pillow speaker jack.
      - (d) Auxiliary alarm monitoring jack.
      - (e) Hospital bed interface jack (when specially approved by TVE - 005OP3B).
      - (f) Provide one (1) spare station for each twenty (20) stations installed.
- M. Distribution System: Refer to Specification Sections 27 11 00, Structured TIP Communications Cables; 27 11 00, TIP Communications Interface and Equipment Rooms Fittings and 27 15 00, HORIZONTAL and Vertical TIP Communications Cabling for additional specific TIP wire and cable standards and installation requirements used to install the Facility's TIP network.
1. In addition to the TIP provided under the aforementioned Specification Sections, the contractor shall provide the following additional TIP installation and testing requirements, provide the following minimum additional System TIP requirements, cables & interconnections:
    - a. Each wire and cable used in the System shall be specifically OEM certified by tags on each reel and recommended and approved for installation in the Facility.
    - b. The Contractor shall provide the RE a 610 mm (2 foot) sample of each wire and/or cable actually employed in the System and each certification tag for approval before continuing with the installation as described herein.
    - c. Fiberoptic Cables: Refer to Specification Section 27 15 00, Horizontal and Vertical TIP Communications Cabling; Paragraph 2.4.C12.d. Fiberoptic Cables – for minimum technical standards and requirements for additional System cables.
    - d. Copper Cables: Refer to Specification Section 27 15 00, Horizontal and Vertical TIP Communications Cabling; Paragraph 2.4.C12.c. Copper Cables – for minimum technical standards and requirements for additional System voice and data cables.
    - e. Line Level Audio and Microphone Cable:
      - 1) Line level audio and microphone cable for inside racks and conduit.
      - 2) Shielded, twisted pair Minimum 22AWG, stranded conductors and 24AWG drain wire with overall jacket.
    - f. Speaker Level Audio (70.7Volt RMS):
      - 1) For use with 70.7V speaker circuits.
      - 2) 18AWG stranded pair, minimum.
    - g. All cabling shall be //plenum// or //riser (UL-1666)// rated.
    - h. Provide one (1) spare 1,000 foot roll of approved System (not microphone) cable only.
  2. Raceways, Back Boxes and conduit:
    - a. In addition to the Raceways, Equipment Room Fittings provided under Specification Sections 27 15 00 TIP Communication Room Fittings and 27 15 00 – TIP Communications Horizontal and Vertical Cabling, provide the following additional TIP raceway and fittings:

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- b. Each raceway that is open top, shall be: UL certified for telecommunications systems, partitioned with metal partitions in order to comply with NEC Parts 517 & 800 to “mechanically separate telecommunications systems of different service, protect the installed cables from falling out when vertically mounted and allow junction boxes to be attached to the side to interface “drop” type conduit cable feeds.
  - c. Intercommunication System cable infrastructure: EMT above accessible ceilings, 24 inches on center.
  - d. Junction boxes shall be not less than 2-1/2 inches deep and 6 inches wide by 6 inches long.
  - e. Flexible metal conduit is prohibited unless specifically approved by 005OP3B.
  - f. System Conduit:
    - 1) The PA system is NFPA listed as Emergency / Public Safety Communication System which requires the entire system to be installed in a separate conduit system.
    - 2) The use of centralized mechanically partitioned wireways may be used to augment main distribution conduit on a case by case basis when specifically approved by VA Headquarters (005OP3B).
    - 3) Conduit Sleeves:
      - (a) The AE has made a good effort to identify where conduit sleeves through full-height and fire rated walls on the drawings, and has instructed the electrician to provide the sleeves as shown on the drawings.
      - (b) While the sleeves shown on the drawings will be provided by others, the contractor is responsible for installing conduit sleeves and fire-proofing where necessary. It is often the case, that due to field conditions, the nurse-call cable may have to be installed through an alternate route. Any conduit sleeves required due to field conditions or those omitted by the engineer shall be provided by the cabling contractor.
  - g. Device Back Boxes:
    - 1) Furnish to the electrical contractor all back boxes required for the PA system devices.
    - 2) The electrical contractor shall install the back boxes as well as the system conduit. Coordinate the delivery of the back boxes with the construction schedule.
3. UPS:
- a. Provide a backup battery or a UPS for the System to allow normal operation and function (as if there was no AC power failure) in the event of an AC power failure or during input power fluctuations for a minimum of 30 minutes.
  - b. As an alternate solution, the telephone system UPS may be utilized to meet this requirement at the headend location, as long as this function is specifically approved by the Telephone Contractor and the RE.
  - c. The Nurse Call Contractor shall not make any attachments or connection to the telephone system until specifically directed to do so, in writing, by the RE.
  - d. Provide UPS for all active system components including but not limited to:
    - 1) System Amplifiers.
    - 2) Microphone Consoles.
    - 3) Telephone Interface Units.
    - 4) TER, TR & Headend Equipment Rack(s).
- N. Patient Bedside Prefabricated Units (PBPU):
- 1. Where PBPU's exist in the Facility; the Contractor shall identify the “gang box” location on the PBPU designated for installation of the telephone jack. This location shall hereinafter be identified as the unit's TCO. The Contractor shall be responsible for obtaining written approval and specific instructions from the PBPU OEM regarding the necessary disassembly and reassembly of each PBPU to the extent necessary to pull wire from



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above the TIP ceiling junction box to the PBPU's reserved gang box for the unit's TCO. A Contractor provided stainless steel cover plate approved for use by the PBPU OEM and Facility IRM Chief shall finish out the jack installation.

2. Under no circumstances shall the Contractor proceed with the PBPU installations without the written approval of the PBPU OEM and the specific instructions regarding the attachment to or modifying of the PBPU. The RE shall be available to assist the Contractor in obtaining approvals and instructions in a timely manner as related to the project's time constraints.
  3. It is the responsibility of the Contractor to maintain the UL integrity of each PBPU. If the Contractor violates that integrity, it shall be the responsibility of the Contractor to obtain on site UL re-certification of the violated PBPU at the direction of the RE and at the Contractor's expense.
- O. Installation Kit:
1. General: The kit shall be provided that, at a minimum, includes all connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks or wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, conduit, cable duct, and/or cable tray, etc., required to accomplish a neat and secure installation. All wires shall terminate in a spade lug and barrier strip, wire wrap terminal or punch block. Unfinished or unlabeled wire connections shall not be allowed. Turn over to the RE all unused and partially opened installation kit boxes, coaxial, fiberoptic, and twisted pair cable reels, conduit, cable tray, and/or cable duct bundles, wire rolls, physical installation hardware. The following are the minimum required installation sub-kits:
    2. System Grounding:
      - a. The grounding kit shall include all cable and installation hardware required. All radio equipment shall be connected to earth ground via internal building wiring, according to the NEC.
      - b. This includes, but is not limited to:
        - 1) Fiberoptic Optic Cable Armor/External Braid
        - 2) Coaxial Cable Shields.
        - 3) Control Cable Shields.
        - 4) Data Cable Shields.
        - 5) Equipment Racks.
        - 6) Equipment Cabinets.
        - 7) Conduits.
        - 8) Cable Duct.
        - 9) Cable Trays.
        - 10) Interduct
        - 11) Power Panels.
        - 12) Connector Panels.
        - 13) Grounding Blocks.
    3. Fiberoptic Cable: The fiberoptic cable kit shall include all fiberoptic connectors, cable tying straps, interduct, heat shrink tubing, hangers, clamps, etc. required to accomplish a neat and secure installation.
    4. Coaxial Cable: The coaxial cable kit shall include all coaxial connectors, cable tying straps, heat shrink tubing, hangers, clamps, etc., required to accomplish a neat and secure installation.
    5. Wire and Cable: The wire and cable kit shall include all connectors and terminals, audio spade lugs, barrier straps, punch blocks, wire wrap strips, heat shrink tubing, tie wraps, solder, hangers, clamps, labels etc., required to accomplish a neat and orderly installation.
    6. Conduit, Cable Duct, and Cable Tray: The kit shall include all conduit, duct, trays, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat and secure conduit, cable duct, and/or cable tray installation in accordance with the NEC and this document.

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7. Equipment Interface: The equipment kit shall include any item or quantity of equipment, cable, mounting hardware and materials needed to interface the systems with the identified sub-system(s) according to the OEM requirements and this document.
    - a. Labels: The labeling kit shall include any item or quantity of labels, tools, stencils, and materials needed to completely and correctly label each subsystem according to the OEM requirements, as-installed drawings, and this document.
  8. Documentation: The documentation kit shall include any item or quantity of items, computer discs, as installed drawings, equipment, maintenance, and operation manuals, and OEM materials needed to completely and correctly provide the system documentation as required by this document and explained herein.
- P. ONCOLOGY, RADIOLOGY, DIALYSIS UNITS – when these units are to be provided as a part of the project, provide each unit as follows with TVE 005OP3B reviewed and approved units designed specifically for service and functions in this type of unit (aka brail, audible and like recognition):
1. CODE BLUE – provide a Code Blue System as described herein.
  2. EMERGENCY STATION:
    - a. A push-button emergency station shall be provided in each toilet stall and each shower/bath facility in Psychiatric Units. Shower emergency stations shall be installed inside the shower stall at the shower head end. They shall be installed approximately a minimum of 18 inches from the showerhead itself and at a maximum of 72 inches above the finished floor. Each station inside shower and toilet areas shall be equipped with a rubber gasket between the faceplate and wall or be rated by UL as waterproof. The gasket shall cover and water seal the entire back box opening and not extend beyond the sides of the associated faceplate by ¼" MAX. If the wall is tile or other uneven type material the gasket and associated faceplate shall be provided to completely seal the opening and uneven material surface.
    - b. Fasten each emergency station faceplate to the back-boxes with tamperproof screws.
    - c. Pressing the push-button on any emergency station shall generate visual signals in the room & corridor dome light(s) and emergency audible and visual signals at the nurse control station.
  3. PATIENT STATION:
    - a. Provide a patient station with pushbutton, microphone/speaker.
    - b. Mount all equipment with tamperproof screws.
    - c. Selection of the patient room station at the nurse control station shall permit two-way voice communication within the room and nurse control station, through the patient wall microphone/speaker.
    - d. Pressing the push-button on any patient wall station shall generate visual signals in the Room & corridor dome light(s) and routine audible and visual signals at the nurse control station.
    - e. The patient wall station shall be equipment with a method (aka separate push-button) to initiate an emergency call in the room and corridor dome lights and nurse call station.
    - f. NURSE CONTROL (aka MASTER) STATION – provide a station as described herein.

### **PART 3 - EXECUTION**

#### **3.01 PROJECT MANAGEMENT**

- A. Assign a single project manager to this project who will serve as the point of contact for the Owner, the General Contractor, and the Engineer.
- B. The Contractor shall be proactive in scheduling work at the hospital, specifically the Contractor will initiate and maintain discussion with the general contractor regarding the schedule for ceiling cover up and install cables to meet that schedule.

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- C. Contact the Office of Telecommunications, Special Communications Team (07A2) at 202-461-5301/5311 to have a VA Certified Telecommunications COTR assigned to the project for telecommunications review, equipment and system approval and co-ordination with VA's Spectrum Management and OCIS Teams.

### **3.02 COORDINATION WITH OTHER TRADES**

- A. Coordinate with the cabling contractor the location of the TV faceplate and the faceplate opening for the nurse call TV control jack.
- B. Coordinate with the cabling contractor the location of TIP equipment in the TER, TCR, PCR, SCC, ECR, STRs, NSs, and TCOs in order to connect to the TIP cable network that was installed as a part of Section Specification 27 11 00. Contact the RE immediately, in writing, if additional location(s) are discovered to be activated that was not previously provided.
- C. Before beginning work, verify the location, quantity, size and access for the following:
  - 1. Isolated ground AC power circuits provided for systems.
  - 2. Primary, emergency and extra auxiliary AC power generator requirements.
  - 3. Junction boxes, wall boxes, wire troughs, conduit stubs and other related infrastructure for the systems.
  - 4. System components installed by others.
  - 5. Overhead supports and rigging hardware installed by others.
- D. Immediately notify the Owner, GC and Consultant(s) in writing of any discrepancies.

### **3.03 NEEDS ASSESSMENT**

- A. Provide a one-on-one meeting with the particular nursing manager of each unit affected by the installation of the new nurse call/code blue system. Review the floor plan drawing, educate the nursing manager with the functions of the equipment that is being provided and gather details specific to the individual units; coverage and priorities of calls; staffing patterns; and other pertinent details that will affect system programming and training.

### **3.04 INSTALLATION**

- A. General:
  - 1. Execute work in accordance with National, State and local codes, regulations and ordinances.
  - 2. Install work neatly, plumb and square and in a manner consistent with standard industry practice. Carefully protect work from dust, paint and moisture as dictated by site conditions. The Contractor will be fully responsible for protection of his work during the construction phase up until final acceptance by the Owner.
  - 3. Install equipment according to OEM's recommendations. Provide any hardware, adaptors, brackets, rack mount kits or other accessories recommended by OEM for correct assembly and installation.
  - 4. Secure equipment firmly in place, including receptacles, speakers, equipment racks, system cables, etc.
    - a. All supports, mounts, fasteners, attachments and attachment points shall support their loads with a safety factor of at least 5:1.
    - b. Do not impose the weight of equipment or fixtures on supports provided for other trades or systems.
    - c. Any suspended equipment or associated hardware must be certified by the OEM for overhead suspension.
    - d. The Contractor is responsible for means and methods in the design, fabrication, installation and certification of any supports, mounts, fasteners and attachments.
  - 5. Finishes for any exposed work such as plates, racks, panels, speakers, etc. shall be approved by the Architect, Owner and TVE 005OP3B.
  - 6. Coordinate cover plates with field conditions. Size and install cover plates as necessary to hide joints between back boxes and surrounding wall. Where cover plates are not fitted

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- with connectors, provide grommets in size and quantity required. Do not allow cable to leave or enter boxes without cover plates installed.
7. Active electronic component equipment shall consist of solid state components, be rated for continuous duty service, comply with the requirements of FCC standards for telephone and data equipment, systems, and service.
  8. Color code all distribution wiring to conform to the Nurse Call Industry Standard, EIA/TIA, and this document, whichever is the more stringent. At a minimum, all equipment, cable duct and/or conduit, enclosures, wiring, terminals, and cables shall be clearly and permanently labeled according to and using the provided record drawings, to facilitate installation and maintenance.
  9. Connect the System's primary input AC power to the Facility' Critical Branch of the Emergency AC power distribution system as shown on the plans or if not shown on the plans consult with RE regarding a suitable circuit location prior to bidding.
  10. Product Delivery, Storage and Handling:
    - a. Delivery: Deliver materials to the job site in OEM's original unopened containers, clearly labeled with the OEM's name and equipment catalog numbers, model and serial identification numbers. The RE may inventory the cable, patch panels, and related equipment.
    - b. Storage and Handling: Store and protect equipment in a manner, which will preclude damage as directed by the RE.
  11. Where TCOs are installed adjacent to each other, install one outlet for each instrument.
  12. Equipment installed outdoors shall be weatherproof or installed in weatherproof enclosures with hinged doors and locks with two keys.
- B. Equipment Racks/Cabinets:
1. Fill unused equipment mounting spaces with blank panels or vent panels. Match color to equipment racks/cabinets.
  2. Provide security covers for all devices not requiring routine operator control.
  3. Provide vent panels and cooling fans as required for the operation of equipment within the OEM' specified temperature limits. Provide adequate ventilation space between equipment for cooling. Follow manufacturer's recommendations regarding ventilation space between amplifiers.
  4. Provide insulated connections of the electrical raceway to equipment racks.
  5. Provide continuous raceway/conduit with no more than 40% fill between wire troughs and equipment racks/cabinets for all non-plenum-rated cable. Ensure each system is mechanically separated from each other in the wireway.
  6. Ensure a minimum of 36 inches around each cabinet and/or rack to comply with OSHA Safety Standards. Cabinets and/or Racks installed side by side – the 36" rule applies to around the entire assembly
- C. Distribution Frames.
1. A new stand-alone (i.e., self supporting, free standing) PA rack/frame may be provided in each TR to interconnect the TCR, PCR, SCC, NS, STRs & ECRs. Rack/frames shall be wired in accordance with industry standards and shall employ "latest state-of-the-art" modular cross-connect devices. The PA riser cable shall be sized to satisfy all voice/digital requirements plus not less than 50% spare (growth) capacity in each TR which includes a fiber optic backbone.
  2. The frames/racks shall be connected to the TER/MCR system ground.
- D. Wiring Practice - in addition to the MANDATORY infrastructure requirements outlined in VA Construction Specifications 27 10 00 – TIP Structured Communications Cabling, 27 11 00 – TIP Communications Rooms Fittings and 27 15 00 – TIP Horizontal and Vertical Communicators Cabling, the following additional practices shall be adhered to:
1. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

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2. Execute all wiring in strict adherence to the National Electrical Code, applicable local building codes and standard industry practices.
3. Wiring shall be classified according to the following low voltage signal types:
  - a. Balanced microphone level audio (below -20dBm) or Balanced line level audio (-20dBm to +30dBm)
  - b. 70V audio speaker level audio.
  - c. Low voltage DC control or power (less than 48VDC)
4. Where raceway is to be EMT (conduit), wiring of differing classifications shall be run in separate conduit. Where raceway is to be an enclosure (rack, tray, wire trough, utility box) wiring of differing classifications which share the same enclosure shall be mechanically partitioned and separated by at least four (4) inches. Where Wiring of differing classifications must cross, they shall cross perpendicular to one another.
5. Do not splice wiring anywhere along the entire length of the run. Make sure cables are fully insulated and shielded from each other and from the raceway for the entire length of the run.
6. Do not pull wire through any enclosure where a change of raceway alignment or direction occurs. Do not bend wires to less than radius recommended by manufacturer.
7. Replace the entire length of the run of any wire or cable that is damaged or abraded during installation. There are no acceptable methods of repairing damaged or abraded wiring.
8. Use wire pulling lubricants and pulling tensions as recommended by the OEM.
9. Use grommets around cut-outs and knock-outs where conduit or chase nipples are not installed.
10. Do not use tape-based or glue-based cable anchors.
11. Ground shields and drain wires to the Facility's signal ground system as indicated by the drawings.
12. Field wiring entering equipment racks shall be terminated as follows:
  - a. Provide OEM directed service loops at harness break-outs and at plates, panels and equipment. Loops should be sufficient to allow plates, panels and equipment to be removed for service and inspection.
  - b. Line level and speaker level wiring may be terminated inside the equipment rack using specified terminal blocks (see "Products.") Provide 15% spare terminals inside each rack. Microphone level wiring may only be terminated at the equipment served.
  - c. If specified terminal blocks are not designed for rack mounting, utilize  $\frac{3}{4}$ " plywood or  $\frac{1}{8}$ " thick aluminum plates/blank panels as a mounting surface. Do not mount on the bottom of the rack.
  - d. Employ permanent strain relief for any cable with an outside diameter of 1" or greater.
13. Use only balanced audio circuits unless noted otherwise directed and indicated on the drawings.
14. Make all connections as follows:
  - a. Make all connections using rosin-core solder or mechanical connectors appropriate to the application.
  - b. For crimp-type connections, use only tools that are specified by the manufacturer for the application.
  - c. Use only insulated spade lugs on screw terminals. Spade lugs shall be sized to fit the wire gauge. Do not exceed two lugs per terminal.
  - d. Wire nuts, electrical tape or "Scotch Lock" connections are not acceptable for any application.
15. Noise filters and surge protectors shall be provided for each equipment interface cabinet, switch equipment cabinet, control console, local, and remote active equipment locations to ensure protection from input primary AC power surges and noise glitches are not induced into low Voltage data circuits.

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16. Wires or cables previously approved to be installed outside of conduit, cable trays, wireways, cable duct, etc:
  - a. Only when specifically authorized as described herein, will wires or cables be identified and approved to be installed outside of conduit. The wire or cable runs shall be UL rated plenum and OEM certified for use in air plenums.
  - b. Wires and cables shall be hidden, protected, fastened and tied at 600 mm (24 in.) intervals, maximum, as described herein to building structure.
  - c. Closer wire or cable fastening intervals may be required to prevent sagging, maintain clearance above suspended ceilings, remove unsightly wiring and cabling from view and discourage tampering and vandalism. Wire or cable runs, not provided in conduit, that penetrate outside building walls, supporting walls, and two hour fire barriers shall be sleeved and sealed with an approved fire retardant sealant.
  - d. Wire or cable runs to system components installed in walls (i.e.: volume attenuators, circuit controllers, signal, or data outlets, etc.) may, when specifically authorized by the RE, be fished through hollow spaces in walls and shall be certified for use in air plenum areas.
  - e. Completely test all of the cables after installation and replace any defective cables.
  - f. Wires or cables that are installed outside of buildings shall be in conduit, secured to solid building structures. If specifically approved, on a case by case basis, to be run outside of conduit, the wires or cables shall be installed, as described herein. The bundled wires or cables must: Be tied at not less than 460 mm (18 in.) intervals to a solid building structure; have ultra violet protection and be totally waterproof (including all connections). The laying of wires or cables directly on roof tops, ladders, drooping down walls, walkways, floors, etc. is not allowed and will not be approved.
- E. Cable Installation - In addition to the MANDATORY infrastructure requirements outlined in VA Construction Specifications 27 10 00 – Structured TIP Communications Cabling, 27 11 00 – TIP Communications Rooms and Fittings and 27 15 00 – TIP Communications Horizontal and Vertical Cabling and the following additional practices shall be adhered to:
  1. Support cable on maximum 2'-0" centers. Acceptable means of cable support are cable trays. Velcro wrap cable bundles loosely to the means of support with plenum rated Velcro straps. Plastic tie wraps are not acceptable as a means to bundle cables.
  2. Run cables parallel to walls.
  3. Install maximum of 10 cables in a single row. Provide necessary rows as required by the number of cables.
  4. Do not lay cables on top of light fixtures, ceiling tiles, mechanical equipment, or ductwork. Maintain at least 2'-0" clearance from all shielded electrical apparatus.
  5. All cables shall be tested after the total installation is fully complete. All test results are to be documented. All cables shall pass acceptable test requirements and levels.  
Contractor shall remedy any cabling problems or defects in order to pass or comply with testing. This includes the re-pull of new cable as required at no additional cost to the Owner.
  6. Ends of cables shall be properly terminated on both ends per industry and OEM's recommendations.
  7. Provide proper temporary protection of cable after pulling is complete before final dressing and terminations are complete. Do not leave cable lying on floor. Bundle and tie wrap up off of the floor until you are ready to terminate.
  8. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
  9. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.
  10. Bundle, lace, and train conductors to terminal points without exceeding OEM's limitations on bending radii. Install lacing bars and distribution spools.

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11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used.
  12. Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.
  13. Separation of Wires: (REFER TO RACEWAY INSTALLATION) Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 12 inches apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.
  14. Serve all cables as follows:
    - a. Cover the end of the overall jacket with a 1" (minimum) length of transparent heat-shrink tubing. Cut unused insulated conductors 2" (minimum) past the heat-shrink, fold back over jacket and secure with cable-tie. Cut unused shield/drain wires 2" (minimum) past the heatshrink and serve as indicated below.
    - b. Cover shield/drain wires with heat-shrink tubing extending back to the overall jacket. Extend tubing 1/4" past the end of unused wires, fold back over jacket and secure with cable tie.
    - c. For each solder-type connection, cover the bare wire and solder connection with heat-shrink tubing.
- F. Labeling: Provide labeling in accordance with ANSI/EIA/TIA-606-A. All lettering for Nurse Call and/or Code Blue circuits shall be stenciled using laser printers or thermal ink transfer process.
1. Cable and Wires (Hereinafter referred to as "Cable"): Cables shall be labeled at both ends in accordance with ANSI/EIA/TIA-606-A. Labels shall be permanent in contrasting colors. Cables shall be identified according to the System "Record Wiring Diagrams."
  2. Equipment: System equipment shall be permanently labeled with contrasting plastic laminate or Bakelite material. System equipment shall be labeled on the face of the unit corresponding to its source.
    - a. Clearly, consistently, logically and permanently mark switches, connectors, jacks, relays, receptacles and electronic and other equipment.
    - b. Engrave and paint fill all receptacle panels using 1/8" (minimum) high lettering and contrasting paint.
    - c. For rack-mounted equipment, use engraved Lamacoid labels with white 1/8" (minimum) high lettering on black background. Label the front and back of all rack-mounted equipment.
  3. Conduit, Cable Duct, and/or Cable Tray: The Contractor shall label all conduit, duct and tray, including utilized GFE, with permanent marking devices or spray painted stenciling a minimum of 3 meters (10 ft.) identifying it as the System. In addition, each enclosure shall be labeled according to this standard.
  4. Termination Hardware: The Contractor shall label TCOs and patch panel connections using color coded labels with identifiers in accordance with ANSI/EIA/TIA-606-A and the "Record Wiring Diagrams."
  5. Where multiple pieces of equipment reside in the same rack group, clearly and logically label each indicating to which room, channel, receptacle location, etc. they correspond.
  6. Permanently label cables at each end, including intra-rack connections. Labels shall be covered by the same, transparent heat-shrink tubing covering the end of the overall jacket. Alternatively, computer generated labels of the type which include a clear protective wrap may be used.
  7. Contractor's name shall appear no more than once on each continuous set of racks. The Contractor's name shall not appear on wall plates or portable equipment.
  8. Ensure each OEM supplied item of equipment has appropriate UL Labels / Marks for the service the equipment is performed permanently attached / marked to a non-removal board in the unit. **EQUIPMENT INSTALLED NOT BEARING THESE UL MARKS WILL NOT BE ALLOWED TO BE A PART OF THE SYSTEM. THE CONTRACTOR SHALL**

BEAR ALL COSTS REQUIRED TO PROVIDE REPLACEMENT EQUIPMENT WITH APPROVED UL MARKS.

- G. Conduit and Signal Ducts: When the Contractor and/or OEM determines additional system conduits and/or signal ducts are required in order to meet the system minimum performance standards outlined herein, the contractor shall provide these items as follows:
1. Conduit:
    - a. The Contractor shall employ the latest installation practices and materials. The Contractor shall provide conduit, junction boxes, connectors, sleeves, weather heads, pitch pockets, and associated sealing materials not specifically identified in this document as GFE. Conduit penetrations of walls, ceilings, floors, interstitial space, fire barriers, etc., shall be sleeved and sealed.
    - b. All cables shall be installed in separate conduit and/or signal ducts (exception from the separate conduit requirement to allow Nurse Call and/or Code Blue cables to be installed in partitioned cable tray with voice cables may be granted in writing by the RE if requested). Conduits shall be provided in accordance with Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and NEC Articles 517 for Critical Care and 800 for Communications systems, at a minimum.
    - c. When metal, plastic covered, etc., flexible cable protective armor or systems are specifically authorized to be provided for use in the System, their installation guidelines and standards shall be as specified herein, Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and the NEC.
    - d. When "interduct" flexible cable protective systems is specifically authorized to be provided for use in the System, it's installation guidelines and standards shall be as specified herein, Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and the NEC.
    - e. Conduit fill (including GFE approved to be used in the system) shall not exceed 40%. Each conduit end shall be equipped with a protective insulator or sleeve to cover the conduit end, connection nut or clamp, to protect the wire or cable during installation and remaining in the conduit. Electrical power conduit shall be installed in accordance with the NEC. AC power conduit shall be run separate from signal conduit.
    - f. Ensure that Critical Care Nurse Call and/or Code Blue Systems (as identified by NEC Section 517) are completely separated and protected from all other systems.
  2. Signal Duct, Cable Duct, or Cable Tray:
    - a. The Contractor shall use GFE signal duct, cable duct, and/or cable tray, when identified and approved by the RE.
    - b. Approved signal and/or cable duct shall be a minimum size of 100 mm x 100 mm (4 in. X 4 in.) inside diameter with removable tops or sides, as appropriate. Protective sleeves, guides or barriers are required on all sharp corners, openings, anchors, bolts or screw ends, junction, interface and connection points.
    - c. Approved cable tray shall be fully covered, mechanically and physically partitioned for multiple electronic circuit use, and be UL certified and labeled for use with telecommunication circuits and/or systems. The RE shall approve width and height dimensions.
    - d. All cable junctions and taps shall be accessible. Provide an 8" X 8" X 4" (minimum) junction box attached to the cable duct or raceway for installation of distribution system passive equipment. Ensure all equipment and tap junctions are accessible

### 3.05 PROTECTION OF NETWORK DEVICES

- A. Contractor shall protect network devices during unpacking and installation by wearing manufacturer approved electrostatic discharge (ESD) wrist straps tied to chassis ground. The wrist strap shall meet OSHA requirements for prevention of electrical shock, should technician come in contact with high voltage.



### **3.06 CUTTING, CLEANING AND PATCHING**

- A. It shall be the responsibility of the contractor to keep their work area clear of debris and clean area daily at completion of work.
- B. It shall be the responsibility of the contractor to patch and paint any wall or surface that has been disturbed by the execution of this work.
- C. The Contractor shall be responsible for providing any additional cutting, drilling, fitting or patching required that is not indicated as provided by others to complete the Work or to make its parts fit together properly.
- D. The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate Contractor the Contractor's consent to cutting or otherwise altering the Work.
- E. Where coring of existing (previously installed) concrete is specified or required, including coring indicated under unit prices, the location of such coring shall be clearly identified in the field and the location shall be approved by the Project Manager prior to commencement of coring work.

### **3.07 FIREPROOFING**

- A. Where Nurse Call and/or Code Blue wires, cables and conduit penetrate fire rated walls, floors and ceilings, fireproof the opening.
- B. Provide conduit sleeves (if not already provided by electrical contractor) for cables that penetrate fire rated walls and Telecommunications Rooms floors and ceilings. After the cabling installation is complete, install fire proofing material in and around all conduit sleeves and openings. Install fire proofing material thoroughly and neatly. Seal all floor and ceiling penetrations.
- C. Use only materials and methods that preserve the integrity of the fire stopping system and its rating.
- D. Install fireproofing where low voltage cables are installed in the same manholes with high voltage cables; also cover the low voltage cables with arc proof and fireproof tape.
- E. Use approved fireproofing tape of the same type as used for the high voltage cables, and apply the tape in a single layer, one-half lapped or as recommended by the manufacturer. Install the tape with the coated side towards the cable and extend it not less than 25 mm (one inch) into each duct.
- F. Secure the tape in place by a random wrap of glass cloth tape.

### **3.08 GROUNDING**

- A. Ground Nurse Call and/or Code Blue cable shields and equipment to eliminate shock hazard and to minimize ground loops, common mode returns, noise pickup, cross talk, and other impairments as specified in CFM Division 27, Section 27 05 26 – Grounding and Bonding for Communications Systems.
- B. Facility Signal Ground Terminal: Locate at main room or area signal ground within the room (i.e. head end and telecommunications rooms) or area(s) and indicate each signal ground location on the drawings.
- C. Extend the signal ground to inside each equipment cabinet and/or rack. Ensure each cabinet and/or rack installed item of equipment is connected to the extended signal ground. Isolate the signal ground from power and major equipment grounding systems.
- D. When required, install grounding electrodes as specified in CFM Division 26, Section 26 05 26 –Grounding and Bonding for Electrical Systems.

- E. Do not use "3rd or 4th" wire internal electrical system conductors for communications signal ground.
- F. Do not connect the signal ground to the building's external lightning protection system.
- G. Do Not "mix grounds" of different systems.
- H. H. Insure grounds of different systems are installed as to not violate OSHA Safety and NEC installation requirements for protection of personnel.

#### **PART 4 – TESTING / GUARANTY / TRAINING**

##### **SYSTEM LISTING**

1. The Nurses Call System is NFPA listed as an "Emergency" Communication system. Where Code Blue signals are transmitted, that listing is elevated to "Life Support/Safety." Therefore, the following testing and guaranty provisions are the minimum to be performed and provided by the contractor and Warranted by the OEM.

##### **PROOF OF PERFORMANCE TESTING**

- I. Intermediate Testing:
  1. After completion of 30 - 40% of the installation of a head end cabinet(s) and interconnection to the corresponding System Patient Head Wall Units and equipment, master stations, local and remote stations, treatment rooms, and prior to any further work, this portion of the system must be pretested, inspected, and certified. Each item of installed equipment shall be checked to ensure appropriate UL Listing and Certification Labels are affixed as required by NFPA -Life Safety Code 101-3.2 (a) & (b), UL Nurse Call Standard 1069 and JCHCO evaluation guidelines, and proper installation practices are followed. The intermediate test shall include a full operational test.
  2. All inspections and tests shall be conducted by an OEM-certified contractor representative and witnessed by TVE-005OP3B if there is no local Government Representative that processes OEM and VA approved Credentials to inspect and certify the system. The results of the inspection will be officially recorded by the Government Representative and maintained on file by the RE, until completion of the entire project. The results will be compared to the Acceptance Test results. An identical inspection may be conducted between the 65 - 75% of the system construction phase, at the direction of the RE.
- J. Pretesting:
  1. Upon completing installation of the Nurse Call and/or Code Blue System, the Contractor shall align, balance, and completely pretest the entire system under full operating conditions.
  2. Pretesting Procedure:
    - a. During the System Pretest the Contractor shall verify (utilizing approved test equipment) that the System is fully operational and meets all the System performance requirements of this standard.
    - b. The Contractor shall pretest and verify that all PSM System functions and specification requirements are met and operational, no unwanted aural effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise, etc. are present. At a minimum, each of the following locations shall be fully pretested:
      - 1) Central Control Cabinets.
      - 2) Nurse Control Stations.
        - (a) Master Stations
        - (b) Patient Stations
        - (c) Staff Stations
        - (d) Emergency Stations
        - (e) Code Blue Stations
      - 3) Dome Lights.
        - (a) Patient Rooms

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- (b) Corridors
  - (c) Intersectional
  - 4) STRs
  - 5) Local and Remote Enunciation Panels (code blue).
  - 6) Electrical Supervision Panels/Functions/locations.
  - 7) All Networked locations.
  - 8) System interface locations (i.e. wireless, PA, telephone, etc.).
  - 9) System trouble reporting.
  - 10) System electrical supervision.
  - 11) UPS operation.
  - 12) Primary / Emergency AC Power Requirements
  - 13) Extra Auxiliary Generator Requirements.
  - 14) NSs.
3. The Contractor shall provide four (4) copies of the recorded system pretest measurements and the written certification that the System is ready for the formal acceptance test shall be submitted to the RE.
- K. Acceptance Test:
- 1. After the Nurse Call and/or Code Blue System has been pretested and the Contractor has submitted the pretest results and certification to the RE, then the Contractor shall schedule an acceptance test date and give the RE 15 working days written notice prior to the date the acceptance test is expected to begin. The System shall be tested in the presence of a TVE 005OP3B and OEM certified representatives. The System shall be tested utilizing the approved test equipment to certify proof of performance and Life Safety / Critical Service compliance. The tests shall verify that the total System meets all the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.
  - 2. The acceptance test shall be performed on a "go-no-go" basis. Only those operator adjustments required to show proof of performance shall be allowed. The test shall demonstrate and verify that the installed System does comply with all requirements of this specification under operating conditions. The System shall be rated as either acceptable or unacceptable at the conclusion of the test. Failure of any part of the System that precludes completion of system testing, and which cannot be repaired in four (4) hours, shall be cause for terminating the acceptance test of the System. Repeated failures that result in a cumulative time of eight (8) hours to affect repairs shall cause the entire System to be declared unacceptable.
  - 3. Retesting of the entire System shall be rescheduled at the convenience of the Government and costs borne by the Contractor at the direction of the SRE.
- L. Acceptance Test Procedure:
- 1. Physical and Mechanical Inspection:
    - a. The TVE 005OP3B Representative will tour all major areas where the Nurse Call and/or Code Blue System and all sub-systems are completely and properly installed to insure they are operationally ready for proof of performance testing. A system inventory including available spare parts will be taken at this time. Each item of installed equipment shall be checked to ensure appropriate UL certification labels are affixed.
    - b. The System diagrams, record drawings, equipment manuals, TIP Auto CAD Disks, intermediate, and pretest results shall be formally inventoried and reviewed.
    - c. Failure of the System to meet the installation requirements of this specification shall be grounds for terminating all testing.
  - 2. Operational Test:
    - a. After the Physical and Mechanical Inspection, the central terminating and nurse call master control equipment shall be checked to verify that it meets all performance requirements outlined herein. A spectrum analyzer and sound level meter may be

- utilized to accomplish this requirement.
- b. Following the central equipment test, a pillow speaker (or on board speaker) shall be connected to the central terminating and nurse call master control equipment's output tap to ensure there are no signal distortions such as intermodulation, data noise, popping sounds, erratic system functions, on any function.
  - c. The distribution system shall be checked at each interface, junction, and distribution point, first, middle, and last intersectional, room, and bed dome light in each leg to verify that the nurse call distribution system meets all system performance standards.
  - d. Each MATV outlet that is controlled by a nurse call pillow speaker shall be functionally tested at the same time utilizing the Contractor's approved hospital grade HDTV receiver and TV remote control cable.
  - e. The RED system and volume stepper switches shall be checked to insure proper operation of the pillow speaker, the volume stepper and the RED system (if installed).
  - f. Additionally, each installed emergency, patient, staff, duty, panic station, intersectional, room, and bed dome light, power supply, code one, and remote annunciator panels shall be checked insuring they meet the requirements of this specification.
  - g. Once these tests have been completed, each installed sub-system function shall be tested as a unified, functioning and fully operating system. The typical functions are: nurse follower, three levels of emergency signaling (i.e. flashing red emergency, flashing white patient emergency, flashing white or combination lights for staff emergency, separate flashing code blue), minimum of 10 minutes of UPS operation, memory saving, minimum of ten station audio paging, canceling emergency calls at each originating station only, and storage and prioritizing of calls.
  - h. Individual Item Test: The TVE 005OP3B Representative will select individual items of equipment for detailed proof of performance testing until 100% of the System has been tested and found to meet the contents of this specification. Each item shall meet or exceed the minimum requirements of this document.
3. Test Conclusion:
- a. At the conclusion of the Acceptance Test, using the generated punch list (or discrepancy list) the VA and the Contractor shall jointly agree to the results of the test, and reschedule testing on deficiencies and shortages with the RE. Any retesting to comply with these specifications will be done at the Contractor's expense.
  - b. If the System is declared unacceptable without conditions, all rescheduled testing expenses will be borne by the Contractor.
- M. Acceptable Test Equipment: The test equipment shall be furnished by the Contractor and shall have a calibration tag of an acceptable calibration service dated not more than 12 months prior to the test. As part of the submittal, a test equipment list shall be furnished that includes the make and model number of the following type of equipment as a minimum:
1. Spectrum Analyzer.
  2. Signal Level Meter.
  3. Volt-Ohm Meter.
  4. Sound Pressure Level (SPL) Meter.
  5. Oscilloscope.
  6. Pillow Speaker Test Set (Pillow Speaker with appropriate load and cross connections in lieu of the set is acceptable).
  7. Patient Push Button Cord Test Set.
  8. Patient Bed with connecting multiple conductor cord.

#### **WARRANTY**

- N. Comply with FAR 52.246-21, except that warranty shall be as follows:
- O. Contractor's Responsibility:

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1. The Contractor shall warranty that all provided material and equipment will be free from defects, workmanship and will remain so for a period of one year from date of final acceptance of the System by the VA. The Contractor shall provide OEM's equipment warranty documents, to the RE (or Facility Contracting Officer if the Facility has taken possession of the building), that certifies each item of equipment installed conforms to OEM published specifications.
2. The Contractor's maintenance personnel shall have the ability to contact the Contractor and OEM for emergency maintenance and logistic assistance, remote diagnostic testing, and assistance in resolving technical problems at any time. This contact capability shall be provided by the Contractor and OEM at no additional cost to the VA.
3. All Contractor maintenance and supervisor personnel shall be fully qualified by the OEM and must provide two (2) copies of current and qualified OEM training certificates and OEM certification upon request.
4. Additionally, the Contractor shall accomplish the following minimum requirements during the two year guaranty period:
  - a. Response Time during the Two Year Guaranty Period:
    - 1) The RE (or Facility Contracting Officer if the system has been turned over to the Facility) is the Contractor's ONLY OFFICIAL reporting and contact official for nurse call system trouble calls, during the guaranty period.
    - 2) A standard work week is considered 8:00 A.M. to 5:00 P.M. or as designated by the RE (or Facility Contracting Officer), Monday through Friday exclusive of Federal Holidays.
  - b. The Contractor shall respond and correct on-site trouble calls, during the standard work week to:
    - (a) A routine trouble call within one (1) working day of its report. A routine trouble is considered a trouble which causes a pillow speaker or cordset, one (1) master nurse control station, patient station, emergency station, or dome light to be inoperable.
    - (b) Routine trouble calls in critical emergency health care facilities (i.e., cardiac arrest, intensive care units, etc.) shall also be deemed as an emergency trouble call. The RE (or Facility Contracting Officer) shall notify the Contractor of this type of trouble call.
    - (c) An emergency trouble call within four hours of its report. An emergency trouble is considered a trouble which causes a sub-system (ward), distribution point, terminal cabinet, or code one system to be inoperable at any time.
  - 2) If a Nurse Call and/or Code Blue/ component failure cannot be corrected within four (4) hours (exclusive of the standard work time limits), the Contractor shall be responsible for providing alternate nurse call equipment. The alternate equipment/system shall be operational within a maximum of 20 hours after the four (4) hour trouble shooting time and restore the effected location operation to meet the System performance standards. If any sub-system or major system trouble cannot be corrected within one working day, the Contractor shall furnish and install compatible substitute equipment returning the System or sub-system to full operational capability, as described herein, until repairs are complete.
- c. Required On-Site Visits during the Two Year Guaranty Period
  - 1) The Contractor shall visit, on-site, for a minimum of eight (8) hours, once every 12 weeks, during the guaranty period, to perform system preventive maintenance, equipment cleaning, and operational adjustments to maintain the System according the descriptions identified in this document.
  - 2) The Contractor shall arrange all Facility visits with the RE (or Facility Contracting Officer) prior to performing the required maintenance visits.
  - 3) Preventive maintenance shall be performed by the Contractor in accordance with the OEM's recommended practice and service intervals during non-busy

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- time agreed to by the RE (or Facility Contracting Officer) and Contractor.
- 4) The preventive maintenance schedule, functions and reports shall be provided to and approved by the RE (or Facility Contracting Officer).
  - 5) The Contractor shall provide the RE (or Facility Contracting Officer) a type written report itemizing each deficiency found and the corrective action performed during each required visit or official reported trouble call. The Contractor shall provide the RE with sample copies of these reports for review and approval at the beginning of the Acceptance Test. The following reports are the minimum required:
    - (a) The Contractor shall provide a monthly summary all equipment and sub-systems serviced during this warranty period to RE (or Facility Contracting Officer) by the fifth (5th) working day after the end of each month. The report shall clearly and concisely describe the services rendered, parts replaced and repairs performed. The report shall prescribe anticipated future needs of the equipment and systems for preventive and predictive maintenance.
    - (b) The Contractor shall maintain a separate log entry for each item of equipment and each sub-system of the System. The log shall list dates and times of all scheduled, routine, and emergency calls. Each emergency call shall be described with details of the nature and causes of emergency steps taken to rectify the situation and specific recommendations to avoid such conditions in the future.
  - 6) The RE (or Facility Contracting Officer) shall convey to the Facility Engineering Officer, two (2) copies of actual reports for evaluation.
    - (a) The RE (or Facility Contracting Officer) shall ensure a copy of these reports is entered into the System's official acquisition documents.
    - (b) The Facility Chief Engineer shall ensure a copy of these reports is entered into the System's official technical record documents.
- P. Work Not Included: Maintenance and repair service shall not include the performance of any work due to improper use; accidents; other vendor, contractor, or owner tampering or negligence, for which the Contractor is not directly responsible and does not control. The Contractor shall immediately notify the RE or Facility Contracting Officer in writing upon the discovery of these incidents. The RE or Facility Contracting Officer will investigate all reported incidents and render

**TRAINING**

- Q. Provide thorough training of all nursing staff assigned to those nursing units receiving new networked nurse/patient communications equipment. This training shall be developed and implemented to address two different types of staff. Floor nurses/staff shall receive training from their perspective, and likewise, unit secretaries (or any person whose specific responsibilities include answering patient calls and dispatching staff) shall receive operational training from their perspective. A separate training room will be set up that allows this type of individualized training utilizing in-service training unit, prior to cut over of the new system.
- R. Provide the following minimum training times and durations:
1. //48// hours prior to opening for nursing staff (in 8-hour increments) – split evenly over 3 weeks and day and night shifts. Coordinate schedule with Owner.
  2. //32// hours during the opening week for nursing staff – both day and night shifts.
  3. //24// hours for supervisors and system administrators.

**3.09 ATTACHMENTS**

- A. The following items are required as a part of the system:

**END OF SECTION**

**SECTION 275241  
MISCELLANEOUS MEDICAL SYSTEMS**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

- A. This section specifies miscellaneous medical equipment and systems including // Behavioral Health psychiatric-grade Security Unit Door Signal Systems, // Narcotics Storage Signal Systems // and // Elapsed Time Indicators // .

**1.02 RELATED WORK**

- A. Low-voltage electric locks and monitoring system: Section 28 13 00, ACCESS CONTROL.
- B. General electrical requirements and items common to more than one section of Division 28: Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
- C. Cables and wiring: Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
- D. Requirements for personal safety and to provide a low impedance path for possible ground fault currents: Section 28 05 26, GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY.

**1.03 SUBMITTALS**

- A. Submit in accordance with Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

**PART 2 PRODUCTS**

**2.01 BEHAVIORAL HEALTH PSYCHIATRIC GRADE SECURITY UNIT DOOR SIGNAL SYSTEMS**

- A. Provide complete system capable of following operation:
  - 1. Doorbell Call Button: Depressing pushbutton at barrier door notifies staff and energizes associated chime and pilot lights, and maintains both in energized position.
  - 2. Door Release Button: Depressing pushbutton at nurses' station de-energizes chime and pilot lights, and unlocks barrier door.
    - a. Coordinate door release operation with electric locks.
    - b. Ensure each unit is, home run, connected to and controlled by facility's Security Management System (SMS) which access control is part.
- B. Components:
  - 1. Provide pilot light, chime, pushbuttons //, electric lock // and auxiliaries for each barrier door to each Behavioral Health Security Unit.
    - a. Provide pilot light with stainless steel cover plate having red LED and integral 120-24 volts transformer.
    - b. Provide chime with a 10-volt ampere, 120-24 volt transformer.
    - c. Provide door control unit operating on 120-volt and containing lock-in maintained relays. Unit must be fail-safe.
    - d. Provide push button rated for 10 amperes, 600 volts, heavy-duty type with stainless steel cover plate.
  - 2. Provide chime and pushbutton at each nurses' station for respective Behavioral Health Security Unit.
  - 3. Provide Red LED in Day Room.
- C. Signs: Provide a sign under each chime and each pilot light, that reads "Barrier Door"; minimum 15 mm (1/2 inch) high lettering.

**2.02 NARCOTICS STORAGE SIGNAL SYSTEMS**

- A. Provide complete system capable of following operation:

1. Door position switches, incorporated in vault and cabinet doors by their manufacturers, control pilot lights connected to facility's SMS.
  2. Each pilot light is energized while its associated door is open.
  3. Coordinate with video surveillance cameras in accordance with Physical Security Design Manual for VA Critical Facilities.
  4. Home run connect each to facility's SMS.
- B. Components:
1. Red pilot light at each narcotic vault door and each narcotic cabinet door.
- C. Signs: Provide a sign under each pilot light, that reads "Narcotics Door"; minimum 15 mm (1/2 inch) high lettering.

## **2.03 MEDICAL ELAPSED TIME INDICATORS**

- A. Provide 0-60 minute range, plus or minus 3 percent of full scale instrument accuracy, medical elapsed time indicator clock.
1. Provide 300 mm (12 inch) dial, flush or semi-flush mounted.
  2. Provide minute hand and sweep-second hand.
  3. Provide black on white, large digits at 5-minute intervals and individual second markings.
  4. Provide completely enclosed synchronous motor.
  5. Provide shock-resistant and dust-proof metal enclosure.
- B. Provide automatic and manual operation, with controls on front of panel and terminals inside panel for connecting remote equipment, which actuates automatic operation.
1. Provide reset switch mounted on front panel; switch resets indicator to zero within five seconds after its momentary activation.
- C. Power Supply: 120 volts, 60 Hz.
- D. Provide solid-state clock with equivalent operational readability, electronic, digital type, and medical elapsed time indicators. Provide with LED display; minimum 65 mm (2-1/2 inch) high numerals.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install wiring in conduit.
- B. Install in accordance with manufacturer's instructions and as indicated.

### **3.02 FIELD QUALITY CONTROL**

- A. Demonstrate that miscellaneous medical systems operate properly in presence of COR.
- B. Test and adjust controls and safeties.
- C. Replace or repair malfunctioning controls, safeties, and equipment not accepted by Government.

**END OF SECTION**



**SECTION 275319**  
**DISTRIBUTED RADIO ANTENNA (WITHIN BUILDING) EQUIPMENT AND SYSTEM**

**PART 1 – GENERAL**

**1.01 GENERAL**

- A. Pursuant to the Department of Veterans Affairs (VA), General Council's (GC) Decision (FY1998 and Grand-Fathered to be fully implemented in FY2000) directing VA that all VOICE (aka TELEPHONE) and DATA (aka DIGITAL) Low Voltage Communications Wires and Cables have been "DECLARED AS BUILDING FIXTURES;" AND are to be provided as a part of the BUILDING STRUCTURE Installed During Construction by Construction and Facilities Management's (CFM) AND each Facility's (VAMC, OPC, CBOPC, etc.) Construction / Renovation Projects.
- B. VA - IS REQUIRED TO INSTALL AND MAINTAIN A STRUCTURED AND FULLY FUNCTIONING COMMUNICATIONS WIRE, CABLE AND SIGNAL DISTRIBUTION TIP CONTAINING ALL LOW VOLTAGE COMMUNICATIONS SYSTEMS, EQUIPMENT, PATHWAY(S), DISTRIBUTION AND INTERFACE POINT[S] THAT RENDERS A FULLY FUNCTIONING TIP FOR EACH VA FACILITY THROUGHOUT ITS MEDICAL CARE NETWORK.
- C. THIS DOCUMENT FORMS BUT ONE (1) PART OF CFM'S REQUIRED FOUR (4) PART TIP TECHNICAL SPECIFICATION REQUIREMENTS. REQUIREMENTS OUTLINED HEREIN AND IN SECTIONS: 27 10 00 – COMMUNICATIONS ROOMS FITTINGS (that included all Outside and In-side TIP Conduit Systems and Equipment; 27 13 00 – COMMUNICATIONS STRUCTURED (aka Backbone) TIP CABLING EQUIPMENT AND SYSTEMS; AND 27 15 00 – COMMUNICATIONS HORIZONTAL TIP CABLING SYSTEMS AND EQUIPMENT.
- D. ADDITIONALLY, THIS DOCUMENT CONTAINS COMMON REFERENCE(S) ADDRESSING ALL DIVISION 27 & 28 SECTIONS AND IS TO BE INCLUDED AS THE BASIC PART OF EACH LOW VOLTAGE SYSTEM'S CONTRACT DOCUMENTS. EACH DIVISION 27 & 28 SECTION WILL REFER BACK TO THE APPROPRIATE PARAGRAPH(S) HEREIN IN-LIEU OF REPEATING THE SAME INFORMATION AND WRITING OVER AN OVER. THE SPEC WRITER IS CAUTIONED TO INSURE EACH APPROPRIATE DIVISION 27 & 28 SECTION IS MADE A PART OF THE CONTRACT PACKAGE WHERE THIS DOCUMENT FORMS THE BASIS FOR ALL (re PART 1.1 STATEMENT). THEREFORE, IN ADDITION TO THE REQUIREMENTS OF SECTION 01 42 19-REFERENCE STANDARDS, THESE DOCUMENTS AND THE INFORMATION DEPICTED HEREIN SHALL BE THE MINIMUM STANDARD(S), CODES AND REQUIREMENTS FOR EACH DIVISION 27 AND 28 COMMUNICATIONS SYSTEM SO IDENTIFIED (re PART 1, PARAGRAPH 1.3.A.1 for VA HEADQUARTERS [aka VACO], and other required project contact information. DO NOT DELETE.)

**1.02 DESCRIPTION**

- A. This Section describes the interfacing, technical and performance requirements for a fully installed, functioning and operating Distributed RF Antenna (Within House) Equipment and System (hereinafter will be referred to as "the system"). The system is based upon outside antenna(s), inside plant, active amplification functions and architecture to support local two way communications for Public Safety Radio (aka Emergency Responder, local and state police, sheriff, ambulance, etc.) Radio Coverage, other RF (VA radios) commercial Wireless Service Providers (WSP), and wireless (Cell) equipment and systems when approved by the AHJ via IWS architecture for the North Bend VA Facility. The Contractor:
- B. SHALL USE ALL SECTIONS IDENTIFIED IN PART 1, PARAGRAPH 1.2 THAT HAVE BEEN DETERMINED, BY VA, NECESSARY FOR THE COMPLETE SYSTEM PROJECT(S), TO THE EXTENT THAT IS DESCRIBED HEREIN AND IN EACH SECTION, IN ORDER TO PROVIDE THE VA FACILITY A STATE-OF-THE-ART, VIABLE, COMPLETE AND FULLY FUNCTIONAL REQUIRED LOW VOLTAGE COMMUNICATIONS SYSTEM(S).

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1. IF A REFERENCED SECTION APPEARS NOT NEEDED, THE CONTRACTOR SHALL NOTIFY THE RE, IN WRITING, OF EXACTLY WHY HE/SHE FEELS THAT PARTICULAR SECTION APPEARS NOT NECESSARY,
  2. THE RE, IN TURN, WILL RESEARCH THE ISSUE AND CONTACT VA'S SMCS (005OP2H3a) FOR AN OFFICIAL TECHNICAL DETERMINATION AND WILL REPLY TO THE CONTRACTOR, IN WRITING, OF THE OFFICIAL CONTRACT DECISION CONCERNING THE REQUEST AFFECTING THE PROJECT, and
  3. Is cautioned to obtain, in writing, all approvals for system changes (i.e., corrections, updates, additions, subtractions, etc.) relating to the published bid contract specifications, drawings and other approved contract document(s), from CFM'S PE, PM and / or the RE BEFORE proceeding with the change.
- C. The voice (telephone) and data portion of the horizontal TIP is managed by VA and/or the Facility's OI&T. The FMS (low-voltage special communications) portion of the TIP is managed by the Facility's FMS with technical assistance provided by VA OI&T's SMCS 005OP2H3.
- D. The system Contractor shall provide all system design, project management, coordination with WSPs and Public Safety, Radio Enhancement / Emergency Responder Services, and with VAMC Entities (ie Police, FMS, OI&T (local for wireless LAN/VoIP) and VACO Spectrum Management (SMCS 005OP2H3B) for technical and RF authorization compliance).
- E. The DAS is designated by VA as an "Emergency and Public Safety" Communications System.

**1.03 RELATED WORK**

- A. SECTIONS MAY - ALL, PART OR NONE be required to form a complete and functioning system depending system design, present and approved future requirements.
- B. In the event of conflict or discrepancy between this Section and the requirements of the PSRAS Code, the requirements stated herein for PSRAS shall govern unless the local PSRAS requirement is more stringent and is furthermore not contrary to the National Requirements for PSRAS.
- C. The Contractor shall identify the portion(s) of this Section that has exceeded the requirements and receive approval from the AHJ and RE for acceptance. The following SECTIONS are the minimum required,
1. 00 01 15 - List of Drawing Sheets.
  2. 01 00 01 - General Conditions.
  3. 01 33 23 – Shop Drawings, Product Data and Samples.
  4. 01 42 19 - Reference Standards.
  5. 01 57 19 - Temporary Environmental Controls.
  6. 01 74 19 - Waste Management.
  7. 07 02 00 – Joint Sealants.
  8. 07 84 00 – Firestopping.
  9. 26 05 26 - Grounding and Bonding for Electrical Systems.
  10. 26 05 33 - Raceways.
  11. 26 41 00 – Facility Lightning Protection.
  12. 27 05 11 – Requirements for Communications Installations.
  13. 27 05 26 – Grounding and Bonding for Communications Systems.
  14. 27 05 33 – Raceways, Conduits and Boxes for Communications Systems.
  15. 27 11 00 – Telecommunications Room Fittings.
  16. 27 15 00 – Communications Structured Cabling
  17. 28 05 13 – Conductors and Cables for Electronic Safety and Security.
  18. 28 05 26 – Grounding and Bonding for Security Systems.
  19. 28 05 28.33 – Conduits and Back boxes for Electronic Safety and Security.
  20. 27 31 00 – Voice Communications Switching Equipment and Systems.
  21. 27 41 31 – Master Antenna Television Equipment and System.
  22. 27 51 16 – Public Address Equipment and Systems.

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23. 27 51 23 – Intercommunications and Program Equipment and System.
24. 27 52 23 – Nurse Call and Code Blue Systems.
25. 27 52 41 – Miscellaneous Medical Systems.

D. The following information is in addition to those identified herein: AHJ Ordinance and / or Supplemental Rules for Public Safety Radio Enhancement / Emergency Responder Amplification Systems.

#### 1.04 DEFINITIONS

- A. In addition to the requirements of SECTION 01 00 01, GENERAL CONDITIONS; the following are made a part of this document:
- B. REVIEW OF CONTRACT DOCUMENTS - a service by the CFM AE, PM, RE AND VACOSMCS to reduce the possibility of materials being ordered which do not comply with contract documents. The review shall not relieve the Contractor of responsibility for dimensions or compliance with the contract documents. The reviewer's failure to detect an error does not constitute VA's permission for the Contractor to proceed in or with the error.
  1. VA Headquarters (aka VACO) Project Review: Is required for National and Local Building Codes, Standards and Guidelines Compliance, contact:
    - a. RE: //XXXXXXXX// CFM, Resident Engineer,
    - b. SRE: //XXXXXXXX// CFM, Senior Resident Engineer,
    - c. PM: //XXXXXXXX// CFM, Project Manager (may be intermixed with the Facility's PM),
    - d. PE: //XXXXXXXX// CFM, Project Executive (also relates to the "Professional Engineer" Certification),
    - e. CO: //XXXXXXXX// CFM, Contracting Officer (may be intermixed with the Facility's CO), and
    - f. Owner: //XXXXXXXX// Typically (VA, VAMC, OPC, CBOC, etc.).
    - g. AE: //XXXXXXXX// CFM's, Contracted Project's Architectural Engineering Firm.
  2. VACO Technical Review: Is required for VA Security; Low Voltage Telecommunications, RF, FAA, FCC and other Spectrum Coordination, Licensing and operating permits; Life and Public Safety, Critical and Emergency Codes, Standards and Guideline Compliance; AND, System(s) Interim and Proof of Performance Testing, VA Final Technical Acceptance, Functional and Operational Certification, contact:
    - a. VACO: Department of Veterans Affairs Office of Telecommunications (005) Telecommunications Engineering (005OP) Spectrum Management and COMSEC Service Special Communications Team (005OP2H3a)  
810 Vermont Avenue NW, (1100 1st NW, Area 501L) Washington, DC 20420  
301-734-0376, 202, 632, 7754 or 202-461-5897
    - b. VACO, OFFICE OF TELECOMMUNICATIONS, ENTERPRISE ENGINEERING, SPECTRUM MANAGEMENT AND COMMUNICATIONS SECURITY (COMSEC) SERVICE (SMCS) IS THE AUTHORITY HAVING JURISDICTION (AHJ – see SME PART 1, PARAGRAPHS 1.3.A.2, 1.3.B.41 & 1.4.B.1.a.[7][a]) FOR THE LOW VOLTAGE SPECIAL COMMUNICATIONS AND COMSEC SYSTEMS AND EQUIPMENT (EXCEPT FIRE ALARM, Telephone and Data); PLUS, RF CO-ORDINATION REQUIRED THROUGH-OUT VA'S MEDICAL SYSTEM BY ORDER OF THE SECRETARY (RE PART 1, PARAGRAPH 1.4.B.1.a.(7)(a): VICE THE SIGNED AND EXECUTED MP-6, PART VIII – TELECOMMUNICATIONS, CHAPTER 5-AUDIO, RADIO AND TELEVISION COMMUNICATIONS SYSTEMS.
      - 1) For each of the DIVISION 27 & 28 Publication referred and used here-in, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should and will" where it appears.
      - 2) Interpret references in these publications to the "AHJ," or words of similar value, to mean the CFM: PE, PM, RE or CO for Project / Contract Guidance; AND VACO SMCS for Technical Concurrence.

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3. Construction Responsible Entities: The following firms / individuals form the Project / Contract's primary core for the building / construction:
  - a. PC: //XXXXXXXX// Prime Contractor (aka General Contractor),
  - b. System Contractor: //XXXXXXXX// The Contractor; you - the successful bidder,
  - c. OEM: //XXXXXXXX// The Systems' "Original Equipment Manufacturer,"
  - d. Project Engineer(s): //XXXXXXXX// The System OEM's:
  - e. Lead Designer,
  - f. Lead Engineer,
  - g. Lead Technician,
  - h. Other OEM Technicians, and
  - i. Project Manager.
- C. THE FOLLOWING ACRONYMS are made a part of this document and are in addition to the ones aforementioned and later herein:
  1. AHJ - Authority Having Jurisdiction – SMCS (005OP2H3) for Low Voltage Telecommunications Systems (Re PART 1, PARAGRAPHS 1.3.A.2.a & b; 1.4.b.1.a. (7) (a) and 1.8.A.& B,
  2. AWG - American Wire Gauge (originally North American Wire Gauge; see STP & UTP) - also known as the Brown & Sharpe wire gauge, is a system used for standardizing all wire and cable conductors cross-sectional area (diameters) that has been in use since c1857 pre-dominantly in the United States and Canada,
  3. AWS - Advanced Wireless Services (synonymous with AWS and UMTS),
  4. BDA – Bi-Directional Amplifier,
  5. BICSI - Building Industries Communications Services Installation,
  6. BIM - Building Information Modeling (aka Model),
  7. BOM - CFE or GFE Bill of Materials,
  8. BUCR - Back-up Computer Room - (re PG 18-10, Page B-5; OI&T Design Guide PG 18-12, Page 4-4),
  9. BTS – Base Transceiver Station,
  10. CFE - Contractor (or OEM) Furnished Equipment,
  11. CFR - Consolidated Federal Regulations - that governs ALL Federal Contracts / Projects.
  12. CUP - Conditional Use Permit(s)-Federal/GSA for VA,
  13. DBm - Decibel, Measured.
  14. DBmV - Decibel per Mili-Volt,
  15. ECC - Engineering Control Center; sometimes referred to The Emergency Control Center, – (see EMCR, re PG 18-10, Page B-5),
  16. EMCR - Emergency Management Control Room” - (see ECC, re PG 18-10, Page B-5),
  17. EMI - Electromagnetic Interference - also called Radio Frequency Interference or RFI when a high frequency (or radio frequency) disturbance affects an electrical circuit due to either electromagnetic induction or electro-magnetic radiation emitted from an external source (see ESI, RFI),
  18. EMT - Electrical Metallic Tubing - relates to “thin wall” non-rigid metal conduit,
  19. ENTR - Utilities Entrance Location (see DEMARC, POTS, LEC)” - (re PG 18-10, Page B-5),
  20. ESI - Electrostatic Interference – also called “Electro-static Discharge Interference (ESD) - ESD is the transfer of static charge between bodies of different electrostatic potential, in the proximity or through direct contact (see EMI, RFI),
  21. ESR - Vendor Engineering Service Report,
  22. ERTF - Real Time Location System,
  23. FA - Fire Alarm - is a system that is installed in VA Facilities to protect the building and installed property,
  24. GFE - Government Furnished Equipment,”

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25. HE - Antenna Head End Room - (re PG 18-10, Page B-5; OI&T De-sign Guide PG 18-12, Page 4-76; see HEC, HEIC, PA, RPEC),
26. HEC - Head End Cabinet(s) - (re PG 18-10, Page B-5; OI&T De-sign Guide PG 18-12, Page 4-76; see HE, HEIC, PA, RPEC),
27. HEIC - Head End Interface Cabinet(s) - (re PG 18-10, Page B-5; OI&T Design Guide PG 18-12, Page 4-76; see HE, HEC, PA RPEC),
28. HSPA - High Speed Packet Access,
29. iDEN – Integrated Digital Enhanced Network,
30. ICRA - Infection Control Risk Assessment,
31. ILSM - Interim Life Safety Measures,
32. ISM – Industrial, Scientific, Medical,
33. LAN - Local Area Network (see VoIP, WAN) – is a digital / data based network localized within a given structure (VA'S LAN IS NOT AUTHORIZED FOR LIFE AND PUBLIC SAFETY, CRITICAL OR EMERGENCY FUNCTIONS UNTIL IT'S CERTIFIED AND LISTED MEETING NFPA'S LIFE SAFETY CODE BY AN AP-PROVED UDOC NRTL – SEE PART 1, PARAGRAPH 1.4.B.1.a. [5]),
34. LBS – Location Based Services,
35. LEC - Local Exchange Carrier - (aka the Local Telephone Company; see DEMARC, PBX & POTS),
36. LMR – Land Mobile Radio,
37. LTE – Long Term Evolution,
38. MCR - Main Computer Room - (re PG 18-10, Page B-5, OI&T De-sign Guide PG 18-12, Pages 2-18, 4-9),
39. MCOR - Main Computer Operators Room - (re PG 18-10, Page B-5),
40. MH - Man Hole (aka Maintenance Holes) are structures used to provide access to outside buried conduit runs in or-der to allow compliance for signal interconnection, protection and long run operations across wide areas and multiple buildings/locations,
41. MOU - Memorandum of Understanding,
42. MW – Microwave (RF Band, Equipment or Services),
43. NID - Network Interface Device - (see DEMARC),
44. NEC – National Electric Code - is the main part of NFPA's Standards and Guides referenced herein,
45. NFPA – National Fire Protection Association - establishes minimum standards for the protection of life and buildings in VA Projects,
46. NOR - Network Operations Room - (re PG 18-10, Page B-5; OI&T Design Guide PG 18-12, Page 4-54),
47. NS - Nurse Station(s) - (re PG 18-10, Page B-5),
48. OI&T - VA's Office of Information and Telecommunications (re OI&T Design Guide PG 18-12, Page 2-1),
49. OSHA - Occupational Safety and Health Administration,
50. OTDR - Optical Time Domain Reflectometer relating to the primary piece of test equipment for evaluating fiberoptic cable plants,
51. PA - Public Address / Cabinet(s) (re PG 18-10, Page B-5; see HE, HEIC, RPEC),
52. PBX - Private Branch Exchange (see DEMARC, LEC, POTS; aka EPBX or Electronic Private Branch Exchange - a reference that is being phased out and will no longer used in VA) is the typical acronym for a Telephone Switch not owned by the Telephone Company that is NFPA CRITICAL SERVICE LIST-ED AND VA APPROVED FOR THE DIRECT MANAGEMENT OF THOSE LIFE SAFETY CODE AND OSHA REQUIRED FACILITIES MANAGEMENT SERVICE'S (FMS) LIFE & PUBLIC SAFETY, CRITICAL AND EMERGENCY COMMUNICATIONS SYSTEMS (re OI&T Design Guide PG 18-12, Page 4-20),
53. PCR - Police Control Room (see SPCC), could be designated SCC” (re PG 18-10, Page B-5),
54. PCS – Personal Communications Service,

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55. POE - Power over Ethernet,
56. POTS - Plain Old Telephone System (see DEMARC, LEC, PBX),
57. PSRAS - Public Safety Radio Amplification Systems,
58. PTS - Pay Telephone Station (may or may not be required); OR may be provided on as a portable station controlled by the using Service Chief (re PG 18-10, Page B-5),
59. PVC - Poly-Vinyl Chloride - relates to a form of plastic,
60. RAN - Radio Access Network,
61. RFI - "Radio Frequency Interference" is the Electromagnetic Radiation which is emitted by electrical circuits carrying rapidly changing signals, as a by-product of their normal operation, and which causes unwanted signals (interference or noise) to be induced in other circuits (see EMI, ESI),
62. RFID - RF Identification,
63. RPEC - Radio Paging Equipment Cabinet(s) - (see HE, HEC, HEIC, PA; PG 18-10, Page B-5),
64. RUS - The DoA's - "Rural Utilities Service" which is technical standards issued (for telecommunications services here-in). Also, RUS BULL is "Rural Utilities Service Bulletin" applied for the aforementioned telecom service,
65. RSSI - Mobile Telecommunications System,
66. RTLS - Real Time Location Service / System,
67. SME - Subject Matter Expert - (re, PART 1-GENERAL, PARA-GRAPHS 1.3.A.2-[VACO SMCS] and 1.4.B.1.a. [7] [a] - VACO SMCS as AJS),
68. SMR - Specialized Mobile Radio,
69. STP - Shielded Twisted Pair (see AWG & UTP)- relating to communications wire and cable that has copper conductors that are twisted to reduce or eliminate interference and crosstalk with an internal cable shield necessary for installation in locations susceptible to high levels of interference,
70. STR - Stacked Telecommunications Rooms; also just Telecommunications Room (see TR) - this term replaces "Signal and/or Telecommunications Closet" that are no longer used. Additionally, each TR shall be designed to provide occupancy for all OI&T AND FMS Low Voltage Communications Systems/Equipment (re Electrical Design Manual, PG 18-10, Sections 7 & 8, Physical Security Design Manual for VA Facilities, PG 18-10 AND OI&T Design Guide PG 18-12, Pages 2-20 & 4-84),
71. TCO - Telecommunications Outlet - is a device that is specifically constructed to afford the TIP a place to terminate in a useable apparatus in designated locations. The TCO's design is detailed herein,
72. TOR - Telephone Operators Room - (re PG 18-10, Page B-5; OI&T Design Guide PG 18-12, Page 4-92),
73. TER - Telephone Equipment Room - (see PBX; re PG 18-10, Page B-5; OI&T Design Guide PG 18-12, Page 4-50),
74. TR - Telecommunications Room - is a standalone room that houses OI & T and FMS equipment and systems cross-connections for servicing a specific area (see STR),
75. UMTS - Universal Mobile Telecommunications System,
76. UPCS - Unlicensed Personal Communications Service
77. UL - Underwriters Laboratories - is one of the approximate 15 USDC approved NRTLs (see PART 1, PARAGRAPH 1.4.B.1.a. [5]),
78. UTP - Unshielded Twisted Pair (see AWG & TWP) - relates to communication wire and cable that has copper conductors and are twisted to reduce or eliminate interference and cross-talk without an internal cable shield,
79. UV - Ultra Violet,
80. VoIP - Voice over Internet Protocol (see PBX, LAN, WAN) - is an emerging technology that is replacing POTS & PBX voice equipment (VA'S VoIP IS NOT AUTHORIZED FOR LIFE & PUBLIC SAFETY, CRITICAL, EMERGENCY OR SAFETY FUNCTIONS UNTIL IT'S CERTIFIED AND LISTED MEETING NFPA'S LIFE SAFETY CODE BY AN

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APPROVED UDOCNRTL – SEE PART 1, PARA-GRAPH 1.4.C.1.e.; OI&T Design Guide PG 18-12, Page 4-14),

- 81. WAN - "Wide Area Network (see LAN, VoIP)" is a digital (data) network that transcends localized LANs within a given structure (VA'S WAN IS NOT AUTHORIZED FOR LIFE & PUBLIC SAFETY, EMERGENCY OR SAFETY FUNCTIONS UNTIL IT'S CERTIFIED AND LISTED MEETING NFPA'S LIFE SAFETY CODE BY AN APPROVED UDOCNRTL – SEE PART 1, PARAGRAPH 1.4.C.1.e; see LAN),
- 82. WiFi – Wireless Fidelity,
- 83. WiMAX – Worldwide Interoperability for MW Access,
- 84. WMTS – Wireless medical Telemetry Service, and
- 85. 24/7 - Is the shortened designation of 24 hours a day, seven days per week and 52 weeks per year.

D. ADDITIONALLY: The following language is required to form a part of this document (re SECTION 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS for additional required information). The terms:

- 1. Provide is considered as being: Designed, engineered, furnished, installed, tested and guaranteed by the Contractor AND the system equipment's OEM; plus, being concurred and certified by SMCS-005OP2H3,

2. Supervision:

a. Electrical	Is the electrical and/or electronic operation of completely (aka full time) analyzing a system's functional components (i.e. cable breaks / shorts), in-operative stations, lights and state(s) of change (i.e. from primary to backup) functions 24/7/365; and provides aural and visual emergency notification signals to at least two remote designated / approved monitoring stations,
b. Government	It is the responsibility of the RE or the RE's assigned inspector to observe the Contractor's employees installing cable, conduit & pathway(s)/ wire way(s), System Ground development and installation, inside and outside plant housings, splices, cleanup, and other related work items associated with the system(s) construction project.
c. Contractor	It is the responsibility of the Contractor to directly manage the Contractor's employees work as outlined by this document throughout the system(s) project.
d. OEM	It is the responsibility of the OEM or the OEM's assigned liaison to assist the Contractor in all functions / requirements / operations outlined herein throughout the project.

- 3. System: Used interchangeably with "The System" is the common word that is applied for each SECTION's specific system in order to shorten each SECTION's written NOT TECHNICAL content,

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4. Work: Materials furnished and completely installed by the Contractor. The System work shall be complete, OSHA NRTL (i.e. [UL]) - Listed AND Labeled on each item of installed equipment / part; AND VACO SMCS 005OP2H3a tested, certified and designated ready for operation (re "Work Performance," PART 1, PARAGRAPH 1.12).
5. Grounding and Bonding (re SECTION 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS):

a. Grounding electrode conductor	Shall refer to the earth grounding electrode that is connected to the separate circulating telecommunications grounding conductor, to the equipment grounding conductor at the source of a separately derived system.
b. Grounding electrode system	Refers to an electrode(s) as specified in the National Electrical Code, Article 250. All electrodes required by NEC, as well as including supplementary, telecommunications system grounding electrodes.
c. Telecommunications Bonding Backbone	Or "TBB" shall refer to a conductor(s) of appropriate size (minimum 1/0 Stranded AWG), which connects each telecommunications main grounding busbar (TMGB) and circulates to interconnect various telecommunications grounding busbars (TGB) and in the locations shown on the drawings.
d. Connect and bond	Are used interchangeably herein and shall mean "the permanent joining of metallic parts to form an electrically conductive path that will assure electrical continuity and the capacity to conduct safely any current likely to be imposed" having the same meaning.
e. effectively grounded	Shall mean intentionally connected to earth through a ground connection or connections of sufficiently low impedance and having sufficient current carrying capacity to prevent the buildup of voltages that may result in undue hazard to connected equipment or persons.
f. Grounding equalizer	Shall refer to the conductor that interconnects elements of the telecommunications grounding infrastructure.

**1.05 APPLICABLE PUBLICATIONS AND VESTED FEDERAL, STATE AND LOCAL LAWS**

- A. In addition with the requirements in SECTION 01 00 01, GENERAL CONDITIONS; the following is made a part of this document:
  1. ORDER OF PRECEDENCE OF APPLYING STANDARDS AND CODES: In the case of a conflict or duplicate code or standard (re PART 1, PARAGRAPHS 1.8.A), use the following deciding guidance for:



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- a. Duplicate Codes / Standards: Use the most recent Federal Code / Standard (unless the State and Local Code addresses increased specific regional safety requirements [ie roof construction in Florida, increased Seismic requirements in California, etc.]), and
  - b. Conflict of Codes / Standards: Use the more stringent Code / Standard.
- B. IN ADDITION TO THE REQUIREMENTS OF SECTION 01 42 19 - REFERENCE STANDARDS (DO NOT DELETE): The following information is made a part of the System's design and installation minimum requirements; and the installation shall fully comply with all governing authorities, laws and ordinances, regulations, and including, but not limited to UNITED STATES FEDERAL LAW and The following Agencies' requirements form a part of the System's Project Documents a directed by formal regulations vested in United States Federal Law:
- C. US Departments of Agriculture, (USDA - Title 7, USC, Chapter 55, Sections 2201, 2202 & 2202) - organized in 1862 by President Abraham Lincoln and formally established by Congress in 1820 & 1825 and final establish Law on February 9, 1889. The following USDA Standards apply to this document:
1. RUS 1755 - Telecommunications Standards and Specifications for Materials, Equipment and Construction,
  2. RUS Bull 1751F-630 - Design of Aerial Cable Plant(s),
  3. RUS Bull 1751F-640 - Design of Buried Cable Plant, Physical Considerations,
  4. RUS Bull 1751F-643 - Underground Plant Design,
  5. RUS Bull 1751F-815 - Electrical Protection of Outside Plant(s),
  6. RUS Bull 1751F-201 - Acceptance Tests of Telecommunications Plant(s) (PC-4),
  7. RUS Bull 1753F-401 - Splicing Copper and Fiber Optic Cables (PC-2),
  8. RUS Bull 345-50 - Trunk Carrier Systems (PE-60),
  9. RUS Bull 345-65 - Shield Bonding Connectors (PE-65),
  10. RUS Bull 345-72 - Filled Splice Closures (PE-74),
  11. RUS Bull 345-83 - Gas Tube Surge Arrestors (PE-80).
- D. US Department of Commerce, (USDC - Public Law 426-62, CFR, Title 15 – Under the Information Technology Management Reform Act; Public Law 104-106, the Secretary of Commerce approves standards and guidelines that are developed by the):
1. National Institute of Standards Technology, (NIST – formerly the National Bureau of Standards, now P/O Commerce). Under Section 5131 of the Information Technology Management Reform Act of 1996 and the Federal Information Security Management Act of 2002 (Public Law 107-347), NIST develops Federal Information Processing Standards Publication (FIPS) requirements, Chapter II. The following NIST FIPS Documents forms a part of this document:
    - a. FIPS PUB 1-1 - Telecommunications Information Ex-change,
    - b. FIPS PUB 100/1 - Interface between Data Terminal Equipment (DTE) Circuit Terminating Equipment for operation with Packet Switched Networks, or Between Two DTEs, by Dedicated Circuit,
    - c. FIPS PUB 140/2 - Telecommunications Information Security Algorithms,
    - d. FIPS PUB 143 - General Purpose 37 Position Interface between DTE and Data Circuit Terminating Equipment,
    - e. EIPS 160/2 - Electronic Data Interchange (EDI),
    - f. FIPS 175 - Federal Building Standard for Telecommunications Pathway and Spaces,
    - g. FIPS 191 - Guideline for the Analysis of Local Area Network Security,
    - h. FIPS 197 - Advanced Encryption Standard (AES)
    - i. FIPS 199 - Standards for Security Categorization of Federal Information and Information Systems.
- E. Federal Communications Commission, (FCC, P/O Commerce - The Communications Act of 1934 [as amended], CFR, Title 47, Telecommunications) – the following FCC Rules /

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Regulations / Requirements applies to this document:

1. Part 15 Restrictions of use for Part 15 listed RF Equipment in Safety of Life Emergency Functions and Equipment Locations (also see CFR, Title 15 – Department of Commerce, Chapter XXIII – NTIA below),
  2. Part 47 Chapter A, Paragraphs 6.1-6.23, Access to Telecommunications Service, Telecommunications Equipment and Customer Premises Equipment,
  3. Part 58 Television Broadcast Service,
  4. Part 73 Radio and Television Broadcast Rules,
  5. Part 90 Rules and Regulations, Appendix C,
  6. Form 854 Antenna Structure Registration.
  7. Chapter XXIII National Telecommunications and Information Administration (NTIA – aka 'Red Book') Chapters 7. 8. / 9; CFR, Title 47 FCC Part 15, RF Restriction of Use and Compliance in "Safety of Life" Functions & Locations.
- F. Department of Defense, (DoD, The National Security Act of 1947) - formed the National Military Establishment; re-organized to The Department of Defense (DoD) on August 10, 1949 as an Amendment to the 1947 Law. The following DoD guidelines apply to this document:
1. MIL-STD-188-110 Interoperability and Performance Standards for Data Modems,
  2. MIL-STD-188-114 Electrical Characteristics of Digital Interface Circuits,
  3. MIL-STD-188-115 Communications Timing and Synchronizations Subsystems,
  4. MIL-C-28883 Advanced Narrowband Digital Voice Terminals.
- G. Department of Health, (HHS, Public Law 96-88, CFR, Title 42, Chapter IV Health & Human Services [HHS], CFR, Title 46, Subpart 1395[a], [b] defines the Joint Commission of Accreditation of Hospital Organization [JCAHO – RE PART 1, PARAGRAPH 1.4.E.1] – The Secretary of HHS has decreed "a hospital that meets JCAHO accreditation is deemed to meet the Medi-care conditions of Participation by meeting Federal Directives)" in:
1. Life Safety System References,
  2. Critical Safety System References,
  3. Public Safety System References,
  4. Telephony System Engineering References,
  5. Data / Digital Systems Engineering References,
  6. Information Security References.
- H. Department of Labor, (DoL, Public Law 426-62 – CFR, Title 29, Part 1910, Chapter XVII - Occupational Safety and Health Administration (OSHA), Occupational Safety and Health Standards). The following OSHA Standards apply to this document:
1. Subpart 7 – defines the requirements for a Nationally Recognized Testing Laboratory (NRTL) – for complete list, of authorized NRTLs contact their below WEB Site. The following are four (4) of the approximate 15 approved NRTLs (obtain a copy at) :([http://www.osha.gov/dts/otpca/nrtl/faq\\_nrtl.html](http://www.osha.gov/dts/otpca/nrtl/faq_nrtl.html))
  2. UL (re Part 1, Paragraph 1.4.B.8): The following UL Standards apply to this document:
    - a. UL01 - Flexible Metal Conduit,
    - b. UL05 - Surface Metal Raceways and Fittings,
    - c. UL06 - Rigid Metal Conduit,
    - d. UL44 - Standard for Thermoset-Insulated Wires and Cables,
    - e. UL50 - Enclosures for Electrical Equipment,
    - f. UL65 - Standard for Wired Cabinets,
    - g. UL83 - Standard for Thermoplastic-Insulated Wires and Cables,
    - h. UL96 - Standard for Lightning Protection Components,
    - i. UL96A - Installation requirements for Lightning Protection Systems,
    - j. UL360 - Liquid-Tight Flexible Steel Conduit,
    - k. UL444 - Communications Cables,
    - l. UL467 - Standard for Electrical Grounding and Bonding Equipment,
    - m. UL468 - Standard for Grounding and Bonding Equipment,

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- n. UL486A - Standard for Wire Connectors and Soldering Lugs for Use with Copper Conductors,
- o. UL486C - Standard for Splicing Wire Connectors,
- p. UL486D - Standard for Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations,
- q. UL486E - Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors,
- r. UL493 - Standard for Thermoplastic-Insulated Under Ground Feeder and Branch Circuit Cable,
- s. UL497 - Protectors for Paired Conductor Communications Circuits,
- t. UL497A - Secondary Protectors for Communications Circuits,
- u. UL510 - Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape,
- v. UL514A - Metallic Outlet Boxes,
- w. UL514B - Standard for Fittings for Cable and Conduit,
- x. UL514C - Non-Metallic Outlet Boxes, Flush Devices and Covers,
- y. UL 651 - Schedule 40 and 80 Rigid PVC Conduit,
- z. UL 797 - EMT,
- aa. UL884 - Under Floor Raceways and Fittings,
- bb. UL1069 - Hospital Signaling and Nurse Call Equipment,
- cc. UL1198 - Distress Signaling.
- dd. UL1242 - Intermediate Medal Conduit,
- ee. UL1333 - Riser Low Smoke Vertical Rating,
- ff. UL1449 - Standard for Transient Voltage Surge Suppressors,
- gg. UL1459 - Standard for Safety, Telephone Equipment,
- hh. UL1479 - Standard for Fire Tests of Through-Penetration Fire Stops,
- ii. UL1666 - Standard for Wire/Cable Vertical (Riser) Tray Flame Tests,
- jj. UL1685 - Vertical Tray Fire Protection and Smoke Re-lease Test for Electrical and Fiber Optic Cables,
- kk. UL1861 - Communication Circuit Accessories,
- ll. UL1863 - Standard for Safety, communications Circuits Accessories,
- mm. UL1865 - Standard for Safety for Vertical-Tray Fire Protection and Smoke-Release Test for Electrical and Optical-Fiber Cables,
- nn. UL2024 - Standard for Optical Fiber Raceways,
- oo. UL2196 - Standard for Test of Fire Resistive Cable,
- pp. UL60950-1/2 - Standard for Safety of Information Technology Equipment Safety.
- 3. Canadian Standards Association, (CSA - same tests as presented by UL),
- 4. Communications Certifications Laboratory, (CCL - same tests as presented by UL),
- 5. Intertek testing Services NA, Inc (ITSNA - formerly Edison Testing Laboratory [ETL] - same tests as presented by UL),
- 6. Subpart 35 - Compliance with NFPA 101, Life Safety Code,
- 7. Subpart 36 - Design and construction requirements for exit routes,
- 8. Subpart 268 - Telecommunications,
- 9. Subpart 305 - Wiring methods, components, and equipment for general use.
- I. Department of Transportation, (DoT, Public Law 85-625, CFR, Title 49, Part 1, Subpart C – Federal Aviation Administration [FAA]) - the following FAA requirements form a part of this document:
  - 1. AC 110/460-ID & AC 707 / 460-2E – Advisory Circulars Standards for Construction of Antenna Towers,
  - 2. 7450 and 7460-2 – Antenna Construction Registration Forms.
  - 3. Federal Specifications for Signal / Communications Standards (FED SPEC) - the following FED SPECS forms a part of this document:
    - a. A-A-59544-00 - Cable and Wire, Electrical (Power, Fixed Installation),

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- b. 1003 - Synchronous Bit Oriented Data Link Control Procedures,
  - c. 1020 - Electrical Characteristics of Balanced Voltage Digital Interface Circuits,
  - d. 1030 - Electrical Characteristics of Un-Balanced Voltage Digital Interface Circuits,  
and
  - e. 1037 - Glossary of Telecommunications Terms.
- J. Department of Veterans Affairs (USDVA or VA, Public Law No. 100-527), CFR, Title 38, Volumes I & II) - the following VA requirements form a part of this document:
- 1. OFFICE OF TELECOMMUNICATIONS, MP-6, PART VIII, TELECOMMUNICATIONS, CHAPTER 5, AUDIO, RADIO AND TELEVISION (and COMSEC) COMMUNICATIONS SYSTEMS (RE PART 1, PARAGRAPH B):
  - 2. Spectrum Management and COMSEC Service (SMCS):
  - 3. FAA, FCC, & NTIA RF Compliance and Licensing Program,
  - 4. COMSEC coordination and control of security / classified communication assets,
  - 5. CoG, "Continuance of Government" communications guidelines and compliance,
  - 6. COOP, "Continuance of Operations" emergency communications guidelines and compliance,
  - 7. Wireless and Handheld Device(s) guidelines and compliance,
  - 8. SATCOM – "Satellite Communications" guidelines and compliance,
  - 9. Low Voltage Special Communications – Construction Contract Specifications and Drawings Conformity, Proof of Performance Testing, VACO Compliance and Life Safety Certification(s) for CFM and VA Facility Low Voltage Special Communications Projects (EXCEPT Fire Alarm, Telephone and Data Systems).
  - 10. Handbook 6100 – Telecommunications: - Cyber and Information Security (OCIS),
  - 11. Handbook 6500 – Information Security Program.
  - 12. VA's National Center for Patient Safety – Veterans Health Administration Warning System, Failure of Medical Alarm Systems using Paging Technology to Notify Clinical Staff, July 2004.
  - 13. VA's Center for Engineering Occupational Safety and Health, concurrence with warning identified in VA Directive 7700.
  - 14. OFFICE OF CFM:
    - a. PG-18-1, Master Construction Specifications (See Paragraph 1.1.2),
    - b. PG-18-4, Standard Detail and CAD Standards
    - c. PG-18-5, Equipment Guide List
    - d. PG-18-10, Manuals by Discipline
    - e. Electrical Design Manual,
    - f. Physical Security, Mission Critical Facilities
    - g. Physical Security, Life-Safety Protected,
    - h. VA Directive 0730, Security and Law Enforcement,
    - i. PG-18-3, Design and Construction Production Procedures
    - j. Fire Protection,
    - k. Heating, Air, Ventilation and Cooling (HAVC),
    - l. PG-18-12, OI&T Design Guide
  - 15. Additional CFM Design Guides & Manuals (re Part 1, Paragraph 1.2),
  - 16. PG-18-15, Minimum Requirements of A/E Submissions:
  - 17. Volume B - Major New Facilities, Major Additions; and Major Renovations, Article VI, Paragraph B,
  - 18. Volume C – Minor and NRM Projects, Article III, Paragraph S,
  - 19. Volume E – Request for Proposals Design/Build Projects, Article II, Paragraph F,
  - 20. Solicitation for Offerors (SFO) for Lease Based Clinics (05-2009).
- K. Local and Regional Codes (LRC): The following Regional requirements form a part of the System's Project Documents as directed by each formal regulation(s) vested in State, City /Town Local Law and Jurisdictional Code(s) / Regulations (re PART 1, PARA-GRAPHS

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1.4.A,E, 1.6 & 1.8.A). The following LRC's apply to this document:

1. State:
2. Law,
3. Hospital Code(s),
4. Regulations,
5. Directives,
6. Codes,
7. Town:
8. Ordinances,
9. Regulations,
10. Codes,
11. City:
12. Ordinances,
13. Regulations,
14. Codes,
15. County:
16. Ordinances,
17. Regulations,
18. Codes.

L. COMMERCIAL / NATIONAL CODES: The following Agencies' requirements have been accepted to form a part of the System's Project Documents as provided by formal agreement(s) by VA and each Agency (re PART 1, PARAGRAPHS 1.4.A,D, 1,6 & 1.8.A):

1. JCAHO – Re PART 1, PARAGRAPH 1.4.C.1.d,
2. American Institute of Architects (AIA) - Guidelines for Health Care Facilities,
3. American National Standards Institute / Electronic Industries Association / Telecommunications Industry Association (ANSI/ EIA / TIA) - the following ANSI/EIA/TIA Standards apply to this document:
  - a. ANSI-C2 - National Electrical Safety Code, Part 2 – Safety Rules for Overhead Lines,
  - b. TIA/EIA-423 - Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits,
  - c. TIA-455-46A - Spectral Attenuation Measurement for Long Length, Graded Index Optical Fibers,
  - d. TIA/EIA-455 - Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and Other Fiber Optic Components,
  - e. TIA-455-78B - Optical Fibers – Part 1-40: Measurement Methods and Test Procedures – Attenuation,
  - f. TIA-455-107 - Determination of Component Reflectance or Link/ System Return Loss using a Loss Test Set,
  - g. TIA/EIA-455-204 - Standard for Measurement of Bandwidth on Multimode Fiber,
  - h. TIA/EIA-455-213 - Optical Fiber Amplifiers, Basic Specification Test methods for Out-of-Band Insertion Losses Filtered Optical Power Meter,
  - i. TIA-472D-000 - Fiber Optic Communications Cable for Outside Plant Use,
  - j. TIA-492AAA - 62.5-Um Core Diameter/125-um Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers,
  - k. TIA-492AAAB - 50-Um Core Diameter/125-Um Cladding Diameter Class IA Graded-Index Multimode Optically Optimized AMERICAN STANDARD FIBERS (DO NOT SUBSTITUTE; re PART 2, PARAGRAPH 2.4.E.2.b.),
  - l. TIA-492CAAA - Detail Specification for Class IVa Dispersion- Unshifted Single-Mode Optical Fibers,
  - m. TIA-492E000 - Sectional Specification for Class IVd Nonzero- Dispersion Single-Mode Optical Fibers for the 1,550 nM Window,

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- n. EIA/TIA 496A - Interface between Data Circuit Terminating Equipment and the Public Switched Telephone Network,
  - o. TIA 526-7 - Measurement of Optical Power Loss of Installed Single Mode Fiber Cable Plant,
  - p. EIA 526-14 - Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant,
  - q. EIA 530 - High Speed 25 Position interface for Data Terminal Equipment and Data Circuit Terminating Equipment,
  - r. TIA 562 - Electrical Characteristics for an Unbalanced Digital Interface,
  - s. TIA 568/0 - Standard for Installing Commercial Building Telecommunications Cabling,
  - t. TIA 568/2 - Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted Pair Cable Components,
  - u. TIA 568-C0 - Telecommunications Cabling for Customer Premises,
  - v. TIA 568-C1 - Commercial Building Telecommunications Cabling Standard,
  - w. TIA 568-C2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standards,
  - x. TIA 568 C3 - Optical Fiber Cabling Components Standard,
  - y. TIA 569-A - Commercial Building Standard for Telecommunications Pathways and Spaces,
  - z. TIA 569-B - Commercial Building Standard for Telecommunications Pathways and Spaces,
  - aa. TIA 569-B.1 - Part 1, General Requirements, Commercial Building Telecommunications Cabling,
  - bb. TIA 574-9 - Position Non-Synchronous Interface between Data Terminal equipment and Data Circuit Terminating Equipment Employing Serial Binary Interchange,
  - cc. TIA-590 - Standard for Physical Location and Protection of Below Ground Fiber Optic Cable Plant,
  - dd. TIA-606A - Administration Standard for the Telecommunications Infrastructure of Communications Buildings,
  - ee. TIA J-STD-607 - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications,
  - ff. EIA 613 - High Speed Serial Interface for Data Terminal Equipment and Data Circuit Terminal Equipment,
  - gg. TIA 668-527 - Wireless Features Description,
  - hh. TIA 758 - Customer Owned Outside Plant Telecommunications Infrastructure Standard,
  - ii. TIA 942 - Telecommunications Infrastructure Standard for Data Centers,
  - jj. TIA 1152 - Requirements for Field Testing Instruments and Measurements for Balanced Twisted Pair Cabling,
  - kk. TIA 1179 - Healthcare Facility Telecommunications Infrastructure Standard,
  - ll. BS EN 50109-2(\*) - Hand Crimping Tools - Tools for The Crimp Termination of Electric Cables and Wires for Low Frequency and Radio Frequency Applications – All Parts & Sections.
4. American Society of Mechanical Engineers (ASME) - the following ASME Standards apply to this document:
- a. Standard 17.4 - Guide for Emergency Personnel,
5. American Society of Testing Material (ASTM) - the following ASTM Standards apply to this document:
- a. B1 - Standard Specification for Hard Drawn Copper Wire,
  - b. B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, or Soft,
  - c. B258 - Standard Specification for Standard Nominal Diameters and Cross-Sectional Areas AWG Sizes of Round Wires Used as Electrical Conductors,

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- d. D709 - Laminated Thermosetting Materials,
  - e. D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup>) (2700 kN-m/m<sup>3</sup>),
  - f. D2301 - Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape,
  - g. D4566 - Standard Test Methods for Electrical Performance Properties of Insulation and Jackets for Telecommunications Wire and Cable.
6. American Telephone and Telegraph Corporation (AT&T)- the following AT&T Publications apply to this document (copies may be obtained at <https://ebiznet.sbc.com/SBCNEBS/>):
- a. ATT-TP-76200 - Network Equipment and Power Grounding, Environmental, and Physical Design Requirements,
  - b. ATT-TP-76305 - Common Systems Cable and Wire Installation and Removal Requirements - Cable Racks and Raceways,
  - c. ATT-TP-76300 - AT&T Installation Requirements (and ICRN's Change Notices),
  - d. ATT-TP-76306 - Electrostatic Discharge Control,
  - e. ATT-TP-76400 - Detail Engineering Requirement (and ICRN's Change Notices),
  - f. ATT-TP-76402 - AT&T Raised Access Floor Engineering and Installation Requirements,
  - g. ATT-TP-76405 - Technical Requirements for Supplemental Cooling Systems in Network Equipment Environments,
  - h. ATT-TP-76416 - Grounding and Bonding Requirements for Network Facilities,
  - i. ATT-TP-76440 - Ethernet Copper Cable & Ethernet Copper Assembly Specification,
  - j. ATT-TP-76450 - Common Systems Equipment Interconnection Standards for the AT&T Local Exchange Companies and AT&T Corporation,
  - k. ATT-TP-76461 - Fiber Optic Cleaning,
  - l. ATT-TP-76900 - AT&T Installation Testing Requirement,
  - m. ATT-TP-76911 - AT&T LEC Technical Publication Notice,
  - n. ATT-812-000-705 - Technical Requirements for Thermal Management Systems in Network Equipment Environments.
- (NOTE: SMCS-005OP2H3a - will evaluate contractor considered and produced equal document(s) to the aforementioned AT&T Commercial Publications, on a case-by-case basis as long as each supplied document is complete and on the originator (not the contractor or OEM) letterhead and enclosed in its published technical binder.
7. Building Industries Communications Services Installation (BICSI) - the following BICSI Standards apply to this document:
- a. All standards for smart building wiring, connections and devices for commercial and medical facilities,
  - b. Standards for Structured Building Cable Topologies,
  - c. Standards in consort with ANSI/EIA/TIA.
8. Institute of Electrical and Electronics Engineers (IEEE) - the following IEEE Standards apply to this document:
- a. C62.41 - Surge Voltages in Low Voltage AC Power Circuits
  - b. SO/TR 21730 - Use of mobile wireless communication and computing technology in healthcare facilities, Recommendations for electromagnetic compatibility (management of unintentional electromagnetic interference) with medical devices,
  - c. 81-1983 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Ground System,
  - d. 100 - The Authoritative Dictionary of IEEE Standards and Terms,
  - e. 0739-5175 - Medical Grade, Mission Critical and Wireless Networks,
  - f. 1100 - Powering and Grounding Sensitive Electronic Equipment.
9. Insulated Cable Engineers Association (ICEA) - the following ICEA Standards apply to this document:
- a. S-87-640 - Optical Fiber Outside Plant Communications Cable,

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- b. S-98-688 - Broadband Twisted Pair Telecommunication Cable, Aircore, Polyolefin Insulated, Copper Conductors Technical Requirements,
  - c. S-99-689 - Broadband Twisted Pair Telecommunication Cable Filled, Polyolefin Insulated, Copper Conductors Technical Requirements.
10. National Electrical Manufacturers Association (NEMA) - the following NEMA Standards form a part of this document:
- a. C62.61 - American National Standard for Gas Tube Surge Arresters on Wire Line Telephone Circuit,
  - b. FB-1 - Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Metallic Tubing and Cable,
  - c. OS-1 - Sheet Steel Outlet Boxes, Device Boxes, Covers and Box Supports,
  - d. TC-3PVC Fittings for Use with Rigid PVC Conduit and Tubing.
11. NFPA - the following NFPA Standards apply to this document:
- a. 69 - National Electrical Safety Code (NES, current date of issue),
  - b. 70 - NEC (current date of issue); Articles 300, 517, 645, 700 & 800,
  - c. 72 - National Fire Alarm and Signaling Code,
  - d. 75 - Standard for Protection of Electronic Computer Data Processing Equipment,
  - e. 76 - Standard for the Fire Protection of Telecommunications Facilities,
  - f. 77 - Recommended Practice on Static Electricity,
  - g. 99 - Healthcare Facilities,
  - h. 101 - Life Safety Code,
  - i. 1221 - Emergency Communications Systems.
12. The Society for Protective Coatings (SSPC) - the following SSPC Standard apply to this document: SSPC SP 6/NACE No.3 - Commercial Blast Cleaning.
13. International Telecommunication Union (ITU) – the following ITU Standard applies to this document: Telecommunication Standardization Sector (ITU-T).

**1.06 QUALIFICATIONS (OEM AND SERVICES)**

- A. MANUFACTURERS (refer to SECTION 2, PARAGRAPH 2.3): The OEM shall have had experience with three (3) or more installations of systems of comparable size and interfacing complexity with regards to type and design as specified herein. Each of these installations shall have performed satisfactorily for at least two (2) years in seriatim after final acceptance by the user. Include the names, locations and point of contact for these installations as a part of the technical submittal (see PART 1, PARAGRAPH 1.8).
1. The Contractor shall submit certified documentation they have been an authorized distributor and service organization for the OEM for a minimum of three (3) years; the:
    - a. Contractor shall provide OEM certification they are authorized to pass thru the OEM's warranty of the installed equipment to VA,
    - b. OEM and Contractor shall accept complete responsibility for the design, installation, certification, operation, and physical support for the System.
  2. The Contractor's Communications Engineers and Technicians as-signed to the System shall be fully trained, qualified, and certified by the OEM on the engineering, installation, operation, and testing of the System. The Contractor shall provide formal written evidence of current OEM certification(s) for the installer(s) as a part of the technical submittal (see PART 1, PARAGRAPH 1.8). VA will not approve technical submittals without this information.
  3. The OEM shall ensure that all management, sales, engineering and installation personnel have read and understand the requirements of this document before the system is provided. The Contractor shall furnish a written statement attesting this requirement as a part of the technical submittal (see PART 1, PARAGRAPH 1.8) that includes each name and certification, including the OEMs. VA will not approve technical submittals without this information.
- B. SERVICES



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1. The System will be delivered free of engineering, manufacturing, installation, and functional defects. It shall be designed, engineered and installed for ease of operation, maintenance, and testing.
2. Provide communications cabling, systems, communications equipment fittings, equipment, conduits, wireways and accessories in accordance with the specifications and drawings. Capacities and ratings of conduit, wireways, cable, locations, other items and arrangements for the specified requirement(s) shall be shown on drawings AND COORDINATED WITH AND LIKE IDENTIFIED IN THE SPECIFICATION CHAPTERS/PARAGRAPHS FOR THE PARTICULAR SYSTEM.

**1.07 CODES AND PERMITS (RE PART 1, PARAGRAPHS 1.4.A, D&E. & 1.8.A)**

- A. Provide all necessary permits and schedule all inspections as identified in the contract's milestone chart, so that the system is proof of performance tested and ready for operation on a date directed by VA.
- B. The OEM and Contractor are responsible to adhere to all codes, standards and requirements described herein.
- C. The Contractor shall display all applicable national, state and local licenses and permits on the Job Site at the direction of the RE.

**1.08 SCHEDULING**

- A. After the award of contract, the Contractor shall prepare detailed and proposed Contractor Project Schedule (CPS - aka milestone chart) using "Microsoft Project" software (or RE approved equivalent). The CPS shall:
  1. Indicate detailed activities for the projected life of the project,
  2. Consist of specific activities and their restraining relationships,
  3. Detail manpower usage throughout the project,
  4. Show expected completed portions of the system, in percentage of the total system, which will be available for interim testing / technical investigation at the direction of the RE.
- B. It is the responsibility of the Contractor to coordinate all work with the other trades for scheduling, rough-in, and finishing all work specified. The VA will not be liable for any additional costs due to missed dates or poor coordination of the Contractor or their supplying trades.

**1.09 REVIEW OF CONTRACT DRAWINGS, EQUIPMENT DATA AND SYSTEM OPERATION SUBMITTALS (AKA TECHNICAL SUBMITTAL[S] – DO NOT DELETE)**

- A. SPECIFICATION ORDER OF PRECEDENCE (Re PART 1, PARAGRAPHS 1.4.A,D,E & 1.6): In the event of a conflict between the text of these documents and the Project's Contract Drawings outlined and / or cited herein; THE TEXT OF DIVISION 27 SECTIONS TAKES PRECEDENCE OVER THE CONTRACT DRAWINGS. HOWEVER, NOTHING HEREIN WILL SUPERSEDE APPLICABLE EMERGENCY AND SAFETY LAWS AND REGULATIONS, SPECIFICALLY NATIONAL AND / OR LOCAL LIFE AND PUBLIC SAFETY CODES.
  1. The Local Fire Marshall and/or VA Public Safety Officer are the only authorities that may modify this document's EMERGENCY CODE COMPLIANCE REQUIREMENTS, on a case by case basis, in writing, with consensus with CFM's PM, PE and/or RE AND SMCS-005OP2H3a.
  2. CFM's PM, PE & RE are the only approving authority's for amendments to this document that may be granted, on a case by case basis, in writing, with technical consensus by SCMS-005OP2H3a and identified Facility Project Personnel.
  3. It is the responsibility of the VA to clarify all issues with this document. When a concern arises – the Contractor shall notify the RE, in writing, on a case by case basis. The RE will render the VA's Official clarification and answer to the Contractor, in writing, covering each submitted question.
  4. The Contractor is again cautioned to obtain in writing, all approvals for system changes relating to the published contract specifications and drawings, from the RE BEFORE proceeding with the change.

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5. Interpret references in these publications to the "AHJ (Re PART 1, PARAGRAPHS D, 1.3.B.1 & 1.4.B.a. (7) (a)," or words of similar value, to mean the CFM: PM, RE or CO for Project / Contract Guidance; AND VACO SMCS for Technical Concurrence.
- B. SUBMITTALS - in addition with the requirements with SECTION 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:

(Note: The Contractor is encouraged, but not required, to submit separate technical submittal(s) outlining additional or separate technical approach(s) to the system requirements stated here-in as long as each alternate technical document(s) is complete, separate, and submitted in precisely the same manner as outlined herein and meets the System Performance Standards. VA will review and rate each received alternate technical submittal in exactly the same procedure as outlined herein. Partial, add-on, or addenda type alternates will not be accepted or reviewed)

  1. VA reserves the right to request the OEM to arrange for a VA Re-representative (that includes SMCS-005OP2H3a) to see typical active systems in operation, when there has been no prior experience with the OEM or the type of equipment being submitted.
  2. VA's approval (that includes SMCS-005OP2H3a certifications) shall be obtained for all equipment and material before delivery to the job site. Delivery, storage, or installation of equipment or material which has not had prior approval will not be permitted at the job site.
  3. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
    - a. Mark the submittals, "SUBMITTED UNDER SECTION \_\_\_\_\_."
    - b. Submittals shall be marked to show specification reference including the section and paragraph numbers ALONG WITH CONTRACT DRAWING REFERENCE.
    - c. Submit each section separately.
  4. Each submittal shall include the following: Information that confirms compliance with contract requirements. Include the OEM's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required drawings, and other Contractor data necessary for VA to ascertain the proposed equipment, materials and system design comply with the system's specification requirements.
    - a. OEM Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted THAT INCLUDES ALL NECESSARY CODE COMPLIANCE FOR EACH ITEM OF SUBMITTED EQUIPMENT.
    - b. IF THE SUPPLIED CUTS DO NOT CONTAIN CODE COMPLIANCE (ie FCC, UL, IEEE, etc.), THE CONTRACTOR SHALL PROVIDE THE TESTING LABORATORY COMPLIANCE SHEETS FOR EACH SUBMITTED EQUIPMENT ITEM.
    - c. Submittals are required to include all equipment anchors and supports, weights, dimensions, center of gravity, standard connections, OEM's recommendations and behavior problems (e.g., vibration, thermal expansion, etc.) associated with equipment, pathway or piping so the proposed installation can be properly reviewed.
      - 1) Manufacturer's Literature and Data: Showing each cable type, rating, testing criteria and performance.
      - 2) Show each physical equipment item(s) (i.e. conduit [outside and inside], conduit connections, penetrations, pathway/ wireway/ cable trays, routes, etc.)//
    - d. Surveys Required as a Part of the Technical Submittal:
      - 1) The Contractor shall provide the following System surveys that depict various system features and capacities required in addition to the on-site survey requirements described herein. Each survey shall be in writing and contain the following information (the formats are suggestions and may be used for the initial Technical Submittal Survey requirements), as a minimum:

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- 2) DAS Cable Design Plan: The DAS Communications Cabling System is in addition to the OEM and Contractor designed functional “Outside and Inside Vertical Riser (Backbone)” Conduit and shall occupy only conduits that were designated “for the DAS Communications Cable System.”
  - (a) The DAS Communications Cable System is to be provided as a part of the technical proposal that will form a fully viable and functioning TIP system.
  - (b) DAS Communications Cable Plant Grounding: REFER TO 27 05 26, GROUNDING AND BONDING for COMMUNICATIONS SYSTEMS for MINIMUM DAS Grounding and Bonding requirements.
- 3) The minimum required DAS Cable Plant Equipment Locations (these are in addition to CFM PG 18-10, Electrical Design Manual, Articles 7 & 8, and Telecommunications One-Line Topology found in the end as a pull-out and Acronym Explanations; AND THE EQUIPMENT ROOM SIZING & LOCATIONS DEPICTED IN OI&T DESIGN GUIDE PG-18-12) are:  
 (Indicate here and at each point on the contract drawings)

EQUIPPED ITEM	CAPACITY	LOCATIONS
SPEP Points of Presence		
Required Location “A”		
Required Location “B”		
DAS Interface Location(s)		
Weatherproofing		
Security Requirements (Physical)		
MHs used to meet system design		
Others		
DAS Interface Location(s)		
Weatherproofing		
Security Requirements (Physical)		
Outside Grab / Pull Boxes used to meet system design		
Others		
DAS Interface Location(s)		
Weatherproofing		
Security Requirements (Physical)		
ENTRs (aka DEMARC – NOTE : THE DEMARC IS TO BE LOCATED IN THE TER //MCR//)		
Required Location “A”		

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Required Location "B"		
Weatherproofing		
DAS Interface Location(s)		
Security Requirements (Physical)		
TER (if used)		
DAS Interface Location(s)		
Backup Batteries (aka UPS)		
Backup Generators (if needed)		
Telephone Console Operators Room		
Telephone Supervisor's Room / Office		
Main Power Source / Location		
Security Requirements (Physical)		
Emergency Systems Management		
Emergency Room		
Boiler Plant		
Security Control Room		
Nurses Station(s)		
Others		
MCR		
MCROR		
Backup Computer Room (if required)		
MCR Supervisor's Room / Office		
MCR's Operations Room / Office		
MCR's Sectional Room / Offices		
DAS Interface Location(s)		
Security Requirements (Physical)		
PCR		
SSCR		
Control Console(s) locations		

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DAS Interface Location(s)		
Security Requirements (Physical)		
Others		
ECR		
Control Console(s) locations		
Main Power Source / Location		
DAS Interface Location(s)		
Security Requirements (Physical)		
Emergency / Disaster Control Room		
Main Power Source / Location		
DAS Interface Location(s)		
Security Requirements (Physical)		
STR(s), Equipment Rack/Cabinet(s) Location(s) & UPS Cabinet(s)		
Others		
Main Power Source / Location		
IDF & TIP Interface Location(s)		
Security Requirements (Physical)		
DAS interface location(s)		
NSs		
Others:		
Main Power Source / Location		
DAS Interface Location(s)		
Security Requirements (Physical)		
HER		
HEC(s)		
Emergency		

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Communication Cabinet(s), Wall Enclosure(s), Roof, PCR & MCR cabling		
Others		
Main Power Source / Location		
DAS Interface Location(s)		
Security Requirements (Physical)		
Other locations required to meet system design		
DAS Telecommunications Outlets (TCOs) Locations		
Depict each DAS TCO size and activated jacks here AND on the contract drawings for each TCO used in each room served by the Outside and Inside TIP		
DAS Interface Location(s)		
1. Basement		
2. Ground Floor		
3. Each Additional Floor		
4. Interstitials		
5. Roof		
6. Others		

- 4) Vertical Riser (Backbone) DAS Cable System Design Plan:
- (a) An OEM and Contractor designed functional DAS Cable System in accordance to the overall plan and plants that will form a part of the Facility's TIP shall be provided as a part of the technical proposal. A specific functioning Voice, Data and Special (FMS) DAS Communications cable distribution system shall coincide with the total growth items as described herein. It is the Contractor's responsibility to provide the Systems' entire DAS Cable System and accessory requirements and engineer a functional DAS distribution system and equipment requirement plan.
  - (b) The minimum required DAS System Backbone Communications Cable and Equipment Locations are in addition to the locations described in CFM PG 18-10, Electrical Design Manual, Articles 7 & 8, and Telecommunications One-Line Topology found in the same document's end as a pull-out and Acronym Explanations.

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- (c) The minimum required “Vertical” DAS Cable Plant Equipment Locations (these are in addition to those described in CFM PG 18-10, Electrical Design Manual, Articles 7 & 8, and Telecommunications One-Line Topology found in the end as a pull-out and Acronym Explanations; AND THE EQUIPMENT ROOM SIZING & LOCATIONS DEPICTED IN OI&T DESIGN GUIDE PG-18-12) are:

(Indicate here and at each point on the contract drawings)

EQUIPPED ITEM	CAPACITY	50% GROWTH
STRs (each floor’s vertical stacked TR)		
Penthouse(s)		
Basement		
Other		

- 5) Horizontal DAS Cable System Design Plan:
- (a) An OEM and Contractor designed functional DAS Cable System in accordance to the overall plan and plants shall be provided as a part of the technical proposal. A specific functioning Voice, Data and Special (FMS) Communications DAS cable distribution system shall coincide with the total growth items as described herein. It is the Contractor’s responsibility to provide the Systems’ entire DAS Cable System and accessory requirements and engineer a functional TIP distribution system and equipment requirement plan.
- (b) The minimum required DAS System Horizontal Communications Cable and Equipment Locations are in addition to the ones identified in CFM PG 18-10, Electrical Design Manual, Articles 7 & 8, and Telecommunications One-Line Topology found in the same document’s end as a pull-out and Acronym Explanations.
- (c) The minimum required “Horizontal” DAS Cable Plant Equipment Locations are in addition to the ones identified in CFM PG 18-10, Electrical Design Manual, Articles 7 & 8, and Telecommunications One-Line Topology found in the end as a pull-out and Acronym Explanations; AND THE EQUIPMENT ROOM SIZING & LOCATIONS DEPICTED IN OI&T DESIGN GUIDE PG-18-12).

- (d) Horizontal DAS Lateral Cables, at a minimum:

(Indicate here and at each point on the contract drawings)

EQUIPPED ITEM	EXPLANATION	CAPACITY	50% GROWTH
TR NR	Identifies the number of cable pairs required to be provided for each floor.		
NUMBER OF CABLE PAIR	Identifies the number of cable pairs required to be provided for each floor.		
NUMBER OF CABLES	Identifies the number of strands in each run of fiber optic cable (TWO		

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	STRANDS PER CABLE PAIR)		
TCOS (Room, Ceiling, Wall, etc)	Identifies the number of cable pairs required to be provided for each TCO.		
INSTALLED METHOD	Identifies the method of installation in accordance with as designated herein		
DAS / TIP	Interface Location(s)		

- e. DAS Devices(s): The Contractor shall clearly and fully indicate this category for each device location and compare the total count to the locations identified as a part of the technical submittal and the contract drawings. Additionally, the Contractor shall indicate the total number of spares.

EQUIPPED ITEM	EXPLANATION	CAPACITY	SPARES
BUILDING	Identifies the building by number, title, or location, and MDF or IDF cabling is provided from		
BUILDING FLOOR	Identifies the floor by number (i.e. 1st, 2nd, etc.)		
TR RM NR	Identifies the room, by number, from which cabling shall be installed		
NUMBER OF ACTIVE TCOs	Identifies the number of jacks activated on each TCO along the DAS distribution horizontal and vertical cable plant		
INSTALLED METHOD	Identifies the method of installation in accordance with as designated herein		
DAS / TIP	Interface Location(s)		

- f. Equipment Parts List (aka BOMs)
- 1) Each interface / connection point shall be provided with internal and external items to maintain a neat and orderly system of DAS equipment, wire, cable and conduit connections and routing that are in addition to the locations in CFM's PG-18-10 Electrical Design Manual for VA Facilities Table 7-1 and Appendix B, Suggested Telecommunications Online Topology for technical assistance in identifying required TIP Interface Points and interconnecting conduit requirements. Identify and record for each SPDP and ENTR(s – aka DEMARC),



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TER, TOR, MCR, MCOR, PCR, SSC, ECR, ST(s), NS(s), HER, HEC, HEIC  
 RPEC and DAS Cable Plant / Room / Area TCOs.

2) Contractor Furnished Equipment Lists (CFELs-BOMS): (See PART 1, SECTION 27 15 00, PARAGRAPH 1.8.4.f.1) for additional instructions)

(a) The Contractor is required to provide a list of the DAS CFE equipment to be furnished. The quantity, make and model number of each DAS item is required. Select the required equipment items quantities that will satisfy the needs of the system as described herein and with the OEM's concurrence applied to the list(s), in writing.

(b) The following equipment items are the minimum requirements of VA to provide an acceptable system described herein.

CONTRACTOR NOTE: Select the required equipment items quantities that will satisfy the needs of the system and edit between the // - - - - //. Do not delete equipment items that are not required – place a “0” in the appropriate Item location.

1. CFE ITEM NUMBER	NUMBER OF UNITS	DESCRIPTION
1.	//As Required//	SPEP Point(s) of entrance
2.	//As Required//	ENT (DEMARC to be in the //TER// //MCR//
2.	//As Required//	TER / TOR
3.	//As Required//	TCR
4.	//As Required//	MCR
5.	//As Required//	PCR
6.	//As Required//	ECR
7.	//As Required//	SSC
8.	//As Required//	PTS
9.	//As Required//	STRs for each floor
10.	//As Required//	NSs
11.	//As Required//	NER
12.m	//As Required//	HE
12.a	//As Required//	DAS TCO(s)
12.a.1	//As Required//	DAS Conduit(s)
12.a.1.a	//As Required//	Rigid
12.a.1.b	//As Required//	PVC
12.a.1.c	//As Required//	Interduct
12.a.1.d	//As Required//	Greenfield
12.a.1.e	//As Required//	Plastic Covered Flex
12.a.1.f	//As Required//	BX
12.a.1.g	//As Required//	OTHER TYPES
13.	//As Required//	DAS Cable Duct
13.a	//As Required//	Wire Duct
13.b	//As Required//	Path Ways
13.c	//As Required//	Race Ways
13.d	//As Required//	Wire Ways
14.	//As Required//	Telecommunications Approved Partitioned Cable Trays
14.a	//As Required//	Telecommunications

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		Approved "Baskets"
14.b	//As Required//	Telecommunications Approved "Cable Ladders"
14.c	//As Required//	"Cable Hook(s) – ONLY WHEN SMCS 005OP2H3 APPROVED
14.d	//As Required//	"Cable Hanger(s) – ONLY WHEN SMCS 005OP2H3 APPROVED
15.e	//As Required//	"O" Ring(s) – ONLY WHEN SCMS 005OP2HE APPROVED
16.	//As Required//	Mounting Assembly(s)
16.a	//As Required//	Terminating Assembly(s)
17.	//As Required//	Cabinet(s) Assembly(s)
17.a	//As Required//	Environmental Cabinet(s) Assembly(s)
17.b	//As Required//	Distribution / Interface Cabinet(s)
17.c	//As Required//	Equipment Rack (aka Radio Relay)
18.	//As Required//	CCS Assembly(s)
18.a	//As Required//	Vertical
18.b	//As Required//	Horizontal
18.c	//As Required//	Room
18.d	//As Required//	Special Interface
19.	//As Required//	Distribution Frames
19.a	//As Required//	DAS Voice
19.b	//As Required//	DAS Data
19.c	//As Required//	Security
19.d	//As Required//	Emergency
19.e	//As Required//	Critical
20.	//As Required//	DAS Distribution Cables
20.a	//As Required//	Voice
20.b	//As Required//	Data
20.c	//As Required//	TWP
20.d	//As Required//	STP
20.e	//As Required//	Fiber-optic
20.f	//As Required//	Multi-mode
20.g	//As Required//	Single-mode
20.h	//As Required//	Baseband
20.i	//As Required//	Audio
20.j	//As Required//	Video
20.k	//As Required//	Other
21.a	//As Required//	DAS Security
21.b	//As Required//	TWP

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21.c	//As Required//	STP
21.d	//As Required//	Fiber-optic
21.e	//As Required//	Multi-mode
21.f	//As Required//	Single-mode
21.g	//As Required//	Baseband
21.h	//As Required//	Audio
21.i	//As Required//	Video
21.j	//As Required//	Other
22.	//As Required//	DAS Emergency
22.a	//As Required//	TWP
22.b	//As Required//	STP
22.c	//As Required//	Fiber-optic
22.d	//As Required//	Multi-mode
22.e	//As Required//	Single-mode
22.f	//As Required//	Baseband
22.g	//As Required//	Audio
22.h	//As Required//	Video
22.i	//As Required//	Other
22.	//As Required//	DAS Critical
23.a	//As Required//	Emergency
23.b	//As Required//	TWP
23.c	//As Required//	STP
23.d	//As Required//	Fiber-optic
23.e	//As Required//	Multi-mode
23.f	//As Required//	Single-mode
23.g	//As Required//	Baseband
23.h	//As Required//	Audio
23.i	//As Required//	Video
23.j	//As Required//	Other
24.	//As Required//	DAS Special Communications
24.a	//As Required//	TWP
24.b	//As Required//	STP
24.c	//As Required//	Fiber-optic
24.d	//As Required//	Multi-mode
24.e	//As Required//	Single-mode
24.f	//As Required//	Baseband
24.g	//As Required//	Audio
24.h	//As Required//	Video
24.i	//As Required//	Coaxial (RF, Video, etc)
24j.j	//As Required//	Other
25.	//As Required//	DAS TCO(s) Connections / Patch
26.	//As Required//	STR(s)
27.	//As Required//	Environmental

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		Requirements
28.	//As Required//	UPS Requirements
29.	//As Required//	Communications Grounding System
30.	1 each	Installation Kit
31.	1 each	Wire Management System
32.	//As Required//	DAS / TIP Interface Points and Systems
33.	//As Required//	OTHER
34. SPECIAL	Number Required by Specification and OEM	Provide System Spares as indicated in each equipment description

- 3) Government Furnished Equipment Lists (GFELs): (See PART 1, SECTION 27 15 00, PARAGRAPH 1.8.4.f.2) for additional instructions)
- (a) The Contractor is required to provide a list of the DAS GFE equipment that has been approved to be used in the system. The quantity, make and model number of each item is required. Select the required equipment items quantities that will satisfy the needs of the system as described herein and with the RE's & OEM's concurrence applied to the list(s), in writing. All GFE that is approved to be used in the system will have the same system warranty applied as described herein.
  - (b) The following DAS GFE equipment items are the ones that have been approved to meet the minimum requirements of VA to provide an acceptable system described herein.

c) GFE ITEM NUMBER	NUMBER OF UNITS	DESCRIPTION
1.		

- g. Shop Drawings: Shall include wiring diagrams and installation details/pictorial of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork and other items that must be shown to ensure a coordinated installation.
    - 1) Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment.
      - (a) Include elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies.
      - (b) All terminal points and wiring shall be identified on wiring diagrams and crossed referenced to the appropriate SPECIFICATION REQUIREMENT.
    - 2) Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.
    - 3) Submittals shall include each nameplate data, size, capacity, applicable federal, military, industry, and technical society publication references.
    - 4) The Contractor shall "update" the submitted shop drawings and wiring diagrams to form a "finished" system technical package as described herein.
  - h. Singular Number: Where any device or part of equipment is referred to herein in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.
5. Certificates - provide the following certifications:
- a. Written certification from the OEM indicating the proposed supervisor of the installation and the proposed provider of the contract maintenance are authorized

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- representatives of the OEM. Include the individual's exact name and address and OEM credentials in the certification.
- b. Written certification from the OEM the installed wiring and connections/diagrams meet National and/or Government Life Safety Guidelines, NFPA, NEC, UL, this specification, and JCAHCO requirements and instructions, recommendations, and guidance set forth by the OEM for the proper performance of the System as described herein. VA will not approve any technical submittal without this certification.
  - c. Pre-acceptance Certification: This Contractor written certification shall be made in accordance with the test procedure out-lined in PART 3 and the material, system and test readings are in accordance with the specifications and drawings and have been properly installed. The Contractor shall include a statement He/ She understands this requirement and will comply at the time stated herein and approved by the RE. VA will not approve any final testing/ system proof of performance and SMCS compliance without this certification.
6. Manuals - Submit in addition to the requirements outlined in SECTION 01 00 00, GENERAL REQUIREMENTS, provide:
- a. Maintenance and Operation Manuals - submit as required for systems and equipment specified in the technical sections. Furnish four (4) copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one (1) complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.
  - b. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
  - c. Provide a "Table of Contents" and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded.
  - d. The manuals shall include:
    - 1) Internal and interconnecting wiring and control diagrams with data to explain detailed system operation and control of the equipment.
    - 2) A control sequence describing startup, operation, and shut-down.
    - 3) Description of the function of each principal item of equipment.
    - 4) Installation and maintenance instructions.
    - 5) Safety precautions.
    - 6) Drawings and illustrations.
    - 7) Testing methods.
    - 8) Performance data.
    - 9) Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
    - 10) Appendix - list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.
7. Approvals will be based on complete submission of manuals together with shop drawings.
8. Samples - A sample of each of the following items shall be furnished to the RE for approval and inventory prior to installation:
- a. One (1) each TCO Wall Outlet Box 4" x 4"x 2.5" with a six (6) // 8" x 8" x 2.5" with a eight (8) // // 12" x 12" x 4" with a twelve (12) // jack outlet body with:
 

a. Two (2) each	telephone (or voice) RJ45 jacks installed and activated.
b. Two (2) each	multi-pin (or data) RJ45 jacks installed

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	and activated.
c. Cover Plate	installed and each jack/port labeled.
d. Fiber optic	//ST// //LC// //other_____// jack(s) installed and activated.
e. Baseband, RF (F)/Video (BNC)/ Audio (XL)	RF (F), video (BNC)/audio (XL) jack(s) installed and activated. (NOTE – IF THE FIBER OPTIC AND BASEBAND [RF, AUDIO] ARE NOT REQUIRED; EACH TCO SHALL BE PROVIDED WITH TWO UNIVERSAL JACK PLUGS. THESE EXTRA PLUGS SHALL BE PROVIDED TO THE RE WITH A SEPARATE INVENTORY SHEET AND BOXED)//

- b. One (1) each data patch panel, punch block or connection de-vice CROSS CONNECTION SYSTEM (CCS) with RJ45 connectors installed.
- c. One (1) each telephone CCS with Insulation Displacement Connectors (IDC) and/or RJ45 connectors and cable terminal and management equipment installed.
- d. One (1) each fiber optic CCS patch panel or breakout box with cable management equipment and //“ST”// //LC// //other// connectors installed.
- e. 305 mm (1 ft.) section of each type of conduit and pathway coupling, bushing and termination fitting indicating the UL or approved alternate testing seal.
- f. 610 mm (2 ft.) section of each raceway and pathway anchors, clamps and supports.
- g. One (1) each package of duct sealing compound.
- h. One (1) sheet of labeling and nomenclature design(s) and scheme(s).
- i. 610 mm (2 ft.) section of each copper cable to be used with OEM cable sweep tags specified herein with //RJ-45// //other// connectors installed.
- j. 610 mm (2 ft.) section of each fiber optic cable to be used with OEM cable sweep tags as specified herein with //“ST”// //LC// //other// connectors installed.
- k. 610 mm (2 ft.) section of each analog RF, video coaxial and audio cable to be used with OEM cable sweep tags as specified herein and OEM specified connectors installed.//
- l. Baseband video CCS patch panel or breakout box with cable management equipment and “BNC” connectors installed.//

**1.10 PROJECT RECORD DOCUMENTS (AKA AS BUILTS):**

- A. In addition to the requirements of SECTION 01 33 23 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES, the following information is made a part of this document’s requirements:
- B. Throughout progress of the Work, maintain an accurate record of changes in and on Contract Documents. Upon completion of Work, transfer recorded changes to a set of Project Record Documents.
- C. The floorplans shall be marked in pen to include the minimum following:
  - 1. Device locations with applied UL labels.
  - 2. Conduit, Cable, Junction Boxes, Interface Points and specific locations.
  - 3. SPSP and specific locations.
  - 4. Manhole(s) and specific location(s).
  - 5. Outside Communication Cable Ducts.
  - 6. ENTR (aka DEMARC) and specific location(s).
  - 7. TER interface equipment and specific location.
  - 8. PA interface equipment and specific location
  - 9. TCR interface equipment and specific location.

10. MCR interface equipment and specific location.
  11. MCOR interface equipment and specific location.
  12. PCR interface equipment and specific location.
  13. ECR interface equipment and specific location.
  14. PTS interface equipment and specific location.
  15. SSC interface equipment and specific location
  16. STR interface equipment and specific locations.
  17. NS interface equipment and specific locations.
  18. HER interface equipment and specific location.
  19. HEC interface equipment and specific location.
  20. HEIC interface equipment and specific location.
  21. RPEC interface equipment and specific location.
  22. TCO equipment and specific locations.
  23. Inside Vertical and Horizontal conduit locations.
  24. Wiring diagram(s).
  25. Labeling and administration documentation.
  26. Warranty certificate.
  27. System test results.
  28. System Completion MOU (if accomplished).
- D. Fifteen (15) working days prior to the acceptance test, the Contractor shall deliver four (4) complete sets of the Record Wiring Diagrams of the System to the RE. The diagrams shall show all inputs and outputs of electronic and passive equipment correctly identified according to the markers installed on the interconnecting cables, equipment and room / area locations.
- E. The Record Wiring Diagrams shall be in hard copy and two (2) compact disk (CD) copies properly formatted to match the Facility's current operating version of Computer Aided Drafting (AutoCAD) system. The RE will verify and inform the Contractor of the version of AutoCAD being used by the Facility.

#### **1.11 USE OF THE SITE**

- A. Use of the site shall be at the PC's direction.
- B. Coordinate with the PC for lay-down areas for product storage and administration areas.
- C. Coordinate work with the PC and their sub-contractors.
- D. Access to buildings wherein the work is performed shall be directed by the PC.

#### **1.12 EQUIPMENT**

- A. EQUIPMENT REQUIREMENTS: Where variations from the contract requirements are requested in accordance with the GENERAL CONDITIONS and SECTION 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.
- B. EQUIPMENT PROTECTION - equipment and materials shall be protected during shipment and storage against theft, physical damage, dirt, moisture, cold and rain:
  1. During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing and operating and repainting if required.
  2. Damaged equipment shall be, as determined by the RE placed in first class operating condition or be returned to the source of supply for repair or replacement.
  3. Painted surfaces shall be protected with factory installed removable heavy craft paper, sheet vinyl or equal.
  4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas is not obvious.

- C. EQUIPMENT INSTALLATION (for additional requirements, see PART 3): Equipment location shall be as close as practical to locations shown on the drawings.
1. Inaccessible Equipment - where the Government determines the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and re-installed as directed by the RE at no additional cost to the Government.
  2. "Conveniently accessible" – equipment is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to: motors, pumps, belt guards, transformers, piping, ductwork, hard ceiling, piping, conduit, raceways, etc.
- D. EQUIPMENT IDENTIFICATION – shall be installed with identification sign(s) and nameplate(s) which clearly indicate information required for use and maintenance of equipment; including, but not limited to:
1. Service Panels,
  2. Faceplates.
  3. Cross-connecting and jacks,
  4. TIP cables,
  5. Conduits and sleeves,
  6. Telecommunication Grounding Bars, Conductors, Connections and System,
  7. Firestop certifications,
  8. Nameplates shall be laminated black phenolic resin with a white core with engraved lettering, a minimum of 6 mm (1/4 inch) high. Secure nameplates with screws. Nameplates that are furnished by the manufacturer as a standard catalog item, or where other method of identification is herein specified, are exceptions that will be considered by the RE and if approved, the Contractor will be given the RE's decision in writing.
- E. DELIVERY, STORAGE, AND HANDLING
1. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft.
  2. Store products in original containers.
  3. Coordinate with the GC for product storage. There may be little or no storage space available on site. Plan to potentially store materials off site.
  4. Do not install damaged products. Remove damaged products from the site and replaced with new product at no cost to the Owner.

### 1.13 WORK PERFORMANCE

- A. Job site safety and worker safety is the responsibility of the Contractor.
- B. For work on existing stations, arrange, phase and perform work to assure communications service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.
- C. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
- D. Coordinate location of equipment and pathways with other trades to minimize interferences. See the GENERAL CONDITIONS.

### 1.14 VA ACCEPTANCE OF SYSTEM MEMORANDUM OF UNDERSTANDING (MOU), CONTRACTORS WARRANTY/ GUARANTEE

- A. MOU – shall be accomplished with written consensus and signatures of the PC; CFM RE / PM / PE / A/E; Facility's PM, CO / COTR & where required, SMCS 005OP2H3a.
  1. Clearly states each system / equipment item / condition(s) needing attention.
  2. Attach the Punch List:



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- a. Initial Inspection document developed by SMCS 005OP2H3 during system proof of performance testing,
  - b. Contractor's documented compliance – listed item by item recorded and verified by VA's RE and Facility's Manager on the original Punch List.
3. VA's Condition of Acceptance of the system language to be the last paragraph of the MOU stating (see PART 3, 3.2.E, Acceptance Test Conclusion for VA "Conditions of Acceptance)."
- a. Without acceptance – until the system fully meets the conditions of the contract; and the system's ownership / use / operation / Warranty / Guarantee to commence at the final acceptance date,
  - b. With conditional acceptance – stating condition(s) that needs addressed by the Contractor / OEM stating the system's ownership / use / operation may commence immediately and its Warranty / Guarantee will commence at the final extended acceptance date,
  - c. Full acceptance – with the system's Ownership / Use / Operation / Warranty / Guarantee to commence at the agreed date of final acceptance.
- B. SYSTEM WARRANTY / GUARANTY - Telecommunication systems are subject to the terms of "Warranty of Construction", FAR clause 52.246-21.
1. Warranty - The Contractor shall pass through the OEM's equipment warranty for a period of one (1) year // (2) years for Life & Public Safety and Emergency System //from the date of acceptance of the system by VA.
  2. Guaranty - the Contractor shall guarantee that system operation, all installed material and equipment will be free from defects, workmanship, and will remain so for a period of one (1) year// (2) years for Life & Public Safety, Critical and Emergency System // from date of final acceptance of the System by the VA.

#### 1.15 SYSTEM PERFORMANCE

- A. GENERAL GUIDELINES: The IWS, herein referred to as the system shall be a DAS. The system shall reliably distribute RF signals and wireless services throughout the specified RF ranges / bands / channels and throughout the specified coverage spaces / areas.
1. The System shall be implemented based on proven state-of-the-art technology that can seamlessly integrate with the rapid evolution of RF, Wireless Technologies and Business Applications.
  2. The System shall include a head-end subsystem. The head-end shall include a wideband RF transceiver(s) for each required RF for the DAS and be a common interface node. The DAS Head End shall be located in the HE Equipment Room // \_\_\_\_\_ // and co-located with VA's FMS RF paging and two way radio systems, DAS PSRAS RF equipment, VA and other RF base stations from multiple cellular common carriers.
  3. The IWS shall have all active elements (aka remote units) in secured TRs located in the FMS portion to simplify maintenance and increase system physical security.
    - a. Locating active elements in or above ceilings is not acceptable.
    - b. Locations for active equipment outside the TRs shall be approved by the AHJ and RE.
  4. Radiating or "leaky" coax systems are not acceptable.
  5. Single Mode Fiber Optic cable, protected by conduit and telecommunications listed "partitioned" cable tray is the preferred transmission media for the DAS "trunk lines."
  6. DAS antenna coverage shall be depicted on the Contractor's Required Survey(s) and additionally shown on the contract drawings as described herein.
  7. The Contractor shall provide coverage antennas and/or "nodes" to meet the RF coverage and operational requirements described herein.
  8. The Contractor shall provide a predictive modeling coverage plan(s) showing the design RF coverage (signal strength) for each RF band required for the System.
  9. The Contractor shall provide plans indicating equipment, antenna, and / or component location(s), cable route(s) and other installation information – identify construction

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elements that would affect the System's performance (ie metallic ceiling materials, air ducts, piping, structural beams, rebar, etc).

10. The Contractor shall provide detail system one-line and functional block / line diagram(s).
- B. Where possible every building DAS should have two independent connections to the TIP Backbone Raceway.
  1. Each DAS connection should enter the building from opposite ends of the building.
  2. Each DAS connection should be brought in through separate TIP paths that provide two distinct DAS connections to the TIP backbone raceway giving each building a redundant connectivity in the case of a cable plant damage.
  3. Due to the number of critical, emergency and safety systems that are now run on the VA Low Voltage TIP it is imperative that we provide redundancy into the TIP. Services such as DAS, fire alarm signaling, Security swipe card door locks, Emergency Phones, Emergency 911, Code Blue, Duress Alarm, Patient / Staff Location, etc. require a highly available, high quality TIP.

## PART 2 – PRODUCTS

### 2.01 GENERAL REQUIREMENTS FOR EQUIPMENT AND MATERIALS:

- A. Furnish and install a complete and fully functional DAS Equipment and cable distribution system for each: SPEP Points of Presence (2 ea), ENTRs (2 ea. - aka DEMARC – NOTE THE DEMARC SHALL BE PROVIDED IN THE //TER// //MCR//), MH(s), Interface Location, TER, PA, TOR, MCR, BCR (if used), MCOR, PCR, SSC, ECC, EMCR, STR(s), NS(s), HER, HEC, HEIC, RPEC and TCO(s) WHOSE COMMUNICATIONS EQUIPMENT ROOM FITTINGS, INSIDE AND OUTSIDE (BACKBONE INCLUDING VERTICAL AND HORIZONTAL) CONDUIT DISTRIBUTION SYSTEMS WERE PROVIDED AS A PART OF SECTION 27 11 00. ADDITIONAL TIP CABLE INSTALLATIONS AND MOUNTING METHOD(S) ARE NOT ALLOWED UNLESS PREVIOUSLY APPROVED BY THE RE AND SMCS 005OP2H3 IN WRITING.
- B. The specific locations for each: SPEP Point of Presence is //\_\_\_\_ & \_\_\_\_ //, MH(s) are //\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, & --- //, ENTR(s) (aka DWMARC[s] TO BE LOCATED IN THE //TER// //MCR// is //\_\_\_\_ & \_\_\_\_ //, Interface Location(s) are //\_\_\_\_, \_\_\_\_\_, & ---- //, TER is //\_\_\_\_, // TOR is //\_\_\_\_, // PA is //\_\_\_\_, // MCR is //\_\_\_\_, // MCOR is //\_\_\_\_, // BCR (if used) is //\_\_\_\_, // PCR //\_\_\_\_, // SSC is //\_\_\_\_, // EMCR //\_\_\_\_, // EEC is //\_\_\_\_, // PTS is //\_\_\_\_, // STR(s) are //\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, & ---- // each NS is //\_\_\_\_, \_\_\_\_\_, & \_\_\_\_\_, // HER //\_\_\_\_, // HIC is //\_\_\_\_, // HC is //\_\_\_\_, // RPEC is //\_\_\_\_// and TCO(s) are //\_\_\_\_, \_\_\_\_\_, //. List all locations here AND indicate each location in/at the required location on the contract drawings.
- C. TCO(s): Deliver at all TCOs fully functional DAS communications cables and 4ea operational jacks (2ea for voice, 2ea for data) in the specific locations shown on the drawings (Note – the inside vertical (Backbone) functional communications cables are in addition to those provided by SECTION 27 10 00 - STRUCTURED (BACKBONE) COMMUNICATIONS CABLING EQUIPMENT AND SYSTEMS; and, horizontal (lateral) functional cables provided by SECTION 27 15 00 – COMMUNICATIONS HORIZONTAL CABLE EQUIPMENT AND SYSTEMS). IF THESE CABLES AND EQUIPMENT ARE FOUND NOT INSTALLED, IMMEDIATELY CONTACT THE RE FOR SPECIFIC DIRECTION[S]).
  1. IN THE ABSENCE OF A/E IDENTIFIED TCO LOCATIONS / COUNTS SUBMITTED DURING THE PROJECTS' DESIGN PHASE(S) – PROVIDE A MINIMUM OF ONE (1) EACH FUNCTIONAL AND OPERATING TCO ON EACH WALL OF EACH DAS ROOM / AREA.
  2. Provide activated special communications DAS functional jacks and corresponding plant, as dictated by the approved system design, in the unused jack space in each of the aforementioned TCOs.
- D. The System shall include, but not be limited to: Directional (a.k.a. Hy-Gain), interior Omni-Directional outdoor antenna(s); coaxial (a.k.a. spiral line) cable and connectors; antenna masts;

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antenna multi-couplers; lightning protection system; HE and interface cabinets; RF terminals and amplifiers; UPS; electronic supervision functions and control consoles; system management, status reporting functions and control consoles; audio volume limiter or compressor; audio amplifiers; audio modulator, adapter, cable, wire and connectors; conduit, cable duct and/or partitioned cable tray; and, necessary passive devices such as fiberoptic and TWP (shielded or unshielded) cable with connectors; attenuators, combiners, traps, filters and splitters: microphones, headphones and/or speakers.

1. The System shall provide DAS two way radio communications from a minimum of the following services:

REQUIREMENTS	FUNCTIONS
a. Three (3) each	Emergency two-way emergency radio responder sub-systems (ie local fire department, police and EMS) to be operated by a separate RF connection to a common antenna coupling network, RF transmission line, and single outside antenna and provide appropriate interconnecting cabling to the system's control units.
b. Three (3) each	VAMC radio sub-systems (ie police, disaster/emergency, code blue paging) by only adding appropriate transmission lines and connecting them to three (3) ports on the aforementioned antenna coupler and provide appropriate interconnecting cabling to the system's control units.
c. Three (3) each	Future commercial cellular or radio sub-systems by only adding appropriate transmission lines and connecting them to three (3) unused ports on the aforementioned antenna coupler and provide appropriate interconnecting cabling to the system control units.
e. Three (3) each	Future // _____ (refer to PARAGRAPH 2.1.A.5 additional system sizing/functional requirements) // radio sub-systems by only adding appropriate transmission lines and connecting them to three (3) unused ports on the aforementioned antenna coupler and provide appropriate interconnecting cabling to the system control units.
f. Plus,	The three (3) emergency responder radio sub-systems; three (3) VAMC radio sub-systems; three (3) future cell/commercial radio sub-systems and three (3) unused (or spare) antenna coupler port(s) shall

	function from the same outside antenna. The system shall allow the installation of an additional antenna coupler at the present or future time when system expansion is require above the numbers identified herein.
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E. Please see PART 2, PARAGRAPH 2.1, SECTION 27 05 00 for additional requirements.

**2.02 SYSTEM DESCRIPTION**

- A. The System shall meet the requirements of the AHJ for PSRAS functions and operation.
1. The DAS shall have active signal handling by using active element(s) that filter and amplify signals on RF specific band/channel basis to consistently deliver In House RF Services at the appropriate power levels in the locations described herein, depicted on the Contractor’s Surveys and on as shown the contract drawings. When any of these mandatory requirements are found missing, contact the RE who will contact SMCS 005OP2H3 for directions.
  2. Frequency Range: The system shall support all RFs between 150 mHz to 5,700 mHz.
  3. The system shall distribute RF coverage at levels described herein in the following minimum areas of the building(s) and as listed herein:

REQUIREMENT	FUNCTION
a. Floor areas	Corridors, Lobbies, Concourse, Interstitial Spaces, Penthouses, Restrooms / Bathrooms
b. External Building lobbies and floor area(s)	Bridges, tunnels and Building links, public spaces (ie courtyards, patios, etc)
c. General use spaces	ie break, staff, public, multipurpose rooms, etc
d. Excluded Areas	NO AREAS ARE EXCLUDED

4. The system shall be able to simultaneously support the following VA APPROVED minimum RF, wireless services, applications and / or technologies. The System shall:
  - a. Distribute cellular channels with signal strength at least +8.0 dBm greater than the signal outside the building and at least -85 dBm “wall to wall” inside the building.
  - b. Meet the:

REQUIREMENT	FUNCTION
1) Wireless Providers needs	ie NEXTEL/SPRINT, VERIZON, AT&T, T-MOBILE, ANY METRO PCS, ETC
// 2) Other	
a)	
b)	
c) //	

- c. Support VA’s FMS and other RF systems (RFs for the following radio systems shall be supported, at a minimum. The DAS Contractor shall confirm the RFs required at the time technical submittal submission and again at Facility opening):

REQUIREMENT	FUNCTION
1) Radio Pagers (aka pocket pagers) in	coordinate with SMCS 005OP2H3 for

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the RF of // _____ //	FCC Restrictions
2) 700 - 800 mHz	FCC Part 15-Safety of Life Restrictions
a) LTE	700 mHz
b) LMR	700 – 800 mHz
3) 800 – 900 mHz)	FCC Part 15-Safety of Life Restrictions
a) SMR	800 – 900 mHz
b) iDEN	800 / 900 mHz
c) Cellular	850 mHz
d) Broadband ISM	800 mHz – 2.4 GHz
e) Super Broadband	800 mHz – 2.9 GHz
f) Extreme Broadband	2.5 GHz – 5.7 GHz
4) One / two way radio paging (900 mHz)	FCC Part 15-Safety of Life Restrictions
5) AWS (1,700 / 2,100 mHz)	FCC Part 15-Safety of Life Restrictions
6) UPCS (1,920 – 1,930 mHz)	FCC Part 15-Safety of Life Restrictions
7) PSRAS Responder(s)	
a) The system shall distribute Public Safety Channels	with a signal strength that exceeds the minimum requirements specified herein and by the AHJ
b) 99 - 100% in house coverage	is expected in all areas of each building
1. Cellular coverage information	shall include expected dBm levels above the exterior macro
2. Note – 700 mHz based systems	now requires a minimum -75 dBm MIMO 2X2 throughout the cellular coverage areas.
c) Public Safety includes	VA, Local, City and State Police, County Sheriff, Emergency Medical Services (EMS), and Fire Departments
1. VHF (150 mHz)	no FCC restriction(s) if RF is assigned to VA
2. UHF (450 – 520 mHz)	no FCC restriction(s) if RF is assigned to VA
3. VA Police _____ mHz	no FCC restriction(s)
4. VA Engineering _____ mHz	no FCC restriction(s)
5. VA Emergency _____ mHz	no FCC restriction(s)
6. VA Disaster _____ mHz	no FCC Restriction(s)
7. Federal Trunking _____ mHz	no FCC restriction(s), FCC Part 25 listed requires MOU & CUP
8. Local PD _____ mHz	no FCC restriction(s), FCC Part 25 listed requires MOU & CUP
9. City PD _____ mHz	FCC restriction(s), FCC Part 25 listed requires MOU & CUP
10. State PD _____ mHz	no FCC restriction(s), FCC Part 25 listed requires MOU & CUP
11. County Sheriff _____ mHz	no FCC restriction(s), FCC Part 25 listed

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		requires MOU & CUP
12.	Fire Department(s) _____mHz	no FCC restriction(s), FCC Part 25 listed requires MOU & CUP
13.	Local EMS(s) _____mHz	no FCC restriction(s), FCC Part 25 listed requires MOU & CUP
d)	Other(s) _____mHz	coordinate with SMCS 005OP2H3 for FCC Restrictions)

- B. Specific Subsystems' Requirements: The system shall have the capability for separate control over each service (and wireless operator) to all the ability to adjust and control power levels without disturbing other services / operators. The System shall:
1. Support multiple services in modular architecture so services can be added or removed without:
    - a. Requiring new infrastructure,
    - b. Readjustment of signal power levels,
    - c. Disturbing existing services.
  2. Enable services to be added without requiring additional cabling or antennas.
  3. Not impede any management feature(s) or functionality or any attached network and / or device management system.
  4. Allow for proactive management and end-to-end alarming of active equipment components, resulting in rapid problem identification and resolution.
  5. Be able to be integrated with third party SNMP based element management system(s) vial a separate internet/POE and provide fault management information and functions throughout the DAS.
  6. Cellular Services:
    - a. The System's transmission media will take many forms, from traditional of-air radio repeater, or Base Transceiver Station (BTS) to a tethered architecture consisting coaxial, fiber optic and/or hybrid fiber optic / coaxial base/trunk solution.
    - b. The DAS shall extend the common wireless carrier services from the head end equipment/system by interfacing to either a passive or active DAS that is deployed to and within each of the building structures. The following system design(s) are meant to be typical only. Prospective Contactors are expected to describe their DAS solution in detail described herein:
      - 1) The System shall support the use of Legacy Cellular Enhancement and technologies such as:
        - (a) GSM,
        - (b) EDGE,
        - (c) UMTS-HSPA.
      - 2) The GPS Navigational Signal must be brought to the Base Station at the System's Head End to support LBS functionally.
  7. The System shall support:
    - a. VA's Single ended and two-way, Non-IP communications radio systems,
    - b. Associated wireless devices that comply with FCC's and Regional regulatory authorities' emission rules for wireless devices.  
 (Note – refer to: FCC Advisory #A, Local Government Official's Guide to Transmitting Antenna RF Emission Safety Rules, Procedures and Practical Guidance, FCC's OET Bulletin 65, FCC Rule 47, Part 15 "Safety of Life prohibitions" and ANSI/IEEE C95.1-1992, Hazardous Emission document)
  8. The System's input AC power shall be provided with and connected to an UPS. The UPS shall support the System operation (under a full load) for a minimum of one (1) hour. The UPS shall be connected to the Facility's Essential Generator Backed-up Electrical System (Note: depending on System design – there may be necessary to provide multiple UPS for the System).

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9. The System shall be provided with an Electrical Supervision Capability that shall monitor all operating states of the System and each UPS. The supervision panel shall contain audible and visual and other devices that will notify maintenance personnel of System Failure(s) and types. The supervision function may be an integral part of the System's component(s); or a separate provided function / capability. The supervision system shall report to two (2) Alarm Panels at two (2) Facility locations (ie Telephone Operator, Security Console, Boiler Plant, MAS Duty Officer, etc) operated 24/7/365 via a System integrated or stand alone plant.
    - a. It is not acceptable to use the Facility's LAN/WAN for the supervision transportation media and management function until it is certified to meet NFPA Life Safety Code 101 and listed or label so accordingly by a NRTL (ie UL).
    - b. The electrical (or electronic) supervision function and alarm(s) shall be provided to a separate Supervision Alarm panel(s) in the FMS Bio-Medical Engineering Shop (or electronic shop if Bio-med does not provide support for the System).
    - c. The Supervision Alarm(s) shall not be cancelled until the trouble / fault has been corrected and the System has been restored to normal operation. The Visual Alarm(s) shall be continuous and the Audible Alarm(s) may be silenced via a controlled circuit that will re-occur the alarm at designated time intervals (ie adjustable form 2 – 30 minutes Maximum).
  10. The System shall be designed to minimize cross talk, background processor noise, inter-modulation and other signal interference. The HE equipment shall be installed and interfaced according to the OEM HE schematic diagram for adjacent audio, video, data and RF channel operation.
  11. The contractor shall provide one (1) spare outside antenna with 100' of RF coaxial cable with connectors installed to be coiled, located and secured in the HE Room and be labeled "DAS EMERGENCY RESPONDER SPARE ANTENNA."
  12. The System shall be able to be accessed via the internet for remote monitoring, software upgrades and maintenance assistance. The internet connection shall be at only one location at the System Headend and controlled by the Facility's OI&T Service. The failure of this approved "external connection" shall not affect the Systems' Performance and Operation.
- C. Cabling
1. Fiber Optic cabling is specified herein and shall be provided on Special System Fiber Optic DAS / TIP Backbone diagrams. The Contractor shall identify in shop drawing submittal one-line riser diagram(s) indicating the mode and number of strands required.
  2. 50 Ohm coaxial cable and terminations as specified herein.
  3. A system distribution design that promotes "looping" the fiber optic and coaxial cables from location to location shall not be permitted. Each location and/or floor fiber optic and coaxial cable transmission line system shall be a "tap" design where each cable is fed from a device provided from a centrally corridor located lateral DAS trunk-line cable(s). Each location or floor lateral DAS trunk-line cable shall be connected to a vertical DAS trunk-line riser cable in the associated TR. Each vertical riser DAS trunk-line cable shall be connected to the HE input and/or output, depending on system design. Distribution (floor or riser) DAS amplifiers may be needed to satisfy the System's DAS received and/or transmit signal level requirements at each location. The provided DAS trunk line that routes throughout the interior of the Facility shall be separated from other systems and protected from damage by conduit and partitioned cable tray.
  4. Each floor and/or office control and interface system shall be protected using conduit and partitioned cable tray. The use of open ladders and "U" clamps, etc is not allowed for installation of Emergency, and/or Support system cables.
  5. Each floor and/or office control and interface system shall be provided in a "buss" design where each location's and/or floor's radio control console and/or control equipment is fed from centrally located (usually in the corridor) lateral trunk-line cables. Each signal closet shall contain a MIN of one terminal cabinet capable of connection to vertical trunk-line

riser cables to lateral trunk-line cables in the associated signal closet and as shown on the drawings or recommended by the OEM.

6. Interface Cabinet Location (Consult Design Guide PG-18-10, Chapters 7 & 8 for specific instructions): Each cabinet shall be provided, protected, and located at the most central distribution system signal closet location to insure optimum origination, reception and control of all system signals. Each cabinet shall be provided with an internal active 120 VAC quad receptacle. Each cabinet shall be provided with a MIN of 610 mm (two feet) clearance from all obstructions in the signal closet where located. Each cabinet shall be provided as required to meet the multiple audio channel and RF requirements and system performance standards.
- D. Interference: There shall be no interference between the applications and wireless operators specified herein and with the Facility's equipment.
- E. Telecommunication Rooms (TR): refer to CFM's EDM and OI&T Design Guide for this requirement if not specifically identified in the projects' construction documents.

### 2.03 MANUFACTURERS

- A. The products specified shall be new; FCC AND NRTL (aka UL) listed, labeled and produced by OEM of record. An OEM of record shall be defined as a company whose main occupation is the manufacture for sale of the items of equipment supplied and which:
  1. Maintains a manufacturer and bench stock of replacement parts for the item(s) submitted,
  2. Maintains technical drawings and specifications; architectural, engineering, depot level repair and operating manuals for the items submitted,
  3. Has published and distributed descriptive literature and equipment specifications on the items of equipment submitted at least 30 days prior to the Invitation for Bid (IFB),
  4. Shall have equipment items that have been in satisfactory operation, on a minimum of three (3) installations of similar size, complexity and type as this project.
    - a. Materials and equipment furnished shall be of current production by OEM(s) regularly engaged in the manufacture of such items, for which replacement parts shall be available for at least five (5) years from the date of acceptance by VA.
    - b. When more than one unit of the same class of equipment is required, the: equipment, cabling, terminating hardware, TCOs, and patch cords shall be sourced from the certifying OEM; OR at the OEM's direction, and support the System design, the OEM's quality control and validity of the OEM's warranty.
  5. VA reserves the right to require the Contractor to submit a list of installations and contact information where the products have been in operation before approval as described in Paragraph 1.8 - "Technical Submittal" portion of this document.
    - a. Equipment Assemblies and Components
      - 1) Components of assembled units need not be products of the same OEM.
      - 2) OEMs of equipment assemblies, which include components made by others, shall assume complete responsibility, warranty and guarantee for the final assembled unit as described herein.
      - 3) Components shall be compatible with each other and with the total assembly for the intended service.
      - 4) Constituent parts which are similar shall be the product of a single OEM.
    - b. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.
- B. Specifications contained herein detail the SALIENT operating and performance characteristics of equipment in order for VA to distinguish acceptable items from unacceptable items of equipment. When an item of equipment is offered or furnished for which there is a specification contained herein, that item of equipment offered or furnished shall meet or exceed the specification.
- C. Equipment Standards and Testing



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1. The System has been defined herein as connected to systems identified and listed as Emergency Care performing Life Support, Emergency and Safety Functions. Therefore, at a minimum, the system shall conform to all aforementioned National and/or Local Life Safety Codes (which ever are the more stringent), NFPA, NEC, this specification, JCAHCO Life Safety Accreditation requirements, and the OEM recommendations, instructions, and guidelines.
  2. The provided equipment required by the System design and approved technical submittal must conform with each NRTL (aka UL) standard in effect for the equipment, as of the date of acceptance of the technical submittal (OR the date when the RE approved system equipment necessary to be replaced) and was technically reviewed and approved by SMCS.
    - a. Where a NRTL (aka UL) standard is in existence for equipment to be used in completion of this contract, the equipment must bear the approved UL Seal or Mark; OR the Seal or Mark of the NRTL Testing Laboratory that warrants the equipment has been tested in accordance with, and conforms to the UL standard(s).
    - b. Contact DoL (OSHA) for an up to date list of NRTLs at:  
[http://www.osha.gov/dts/otpca/nrtl/faq\\_nrtl.html](http://www.osha.gov/dts/otpca/nrtl/faq_nrtl.html)
    - c. The placement of the NRTL (aka UL) Seal or Mark shall be on a permanent part of the equipment that is not capable of being transported from one equipment item to another.
- D. When Factory Testing is Determined Necessary:
1. VA shall have the option of witnessing factory tests. The Contractor shall notify the VA through the RE a minimum of 21 days (aka three [3] weeks) prior to the OEMs making the factory tests.
  2. The OEM shall furnish four (4) copies of certified test reports containing all test data to the RE prior to final inspection and not more than 30 days after completion of the tests.
  3. When equipment fails to meet factory test and reinspection is required, the OEM shall be liable for all additional expenses, including expenses of the Government.

## 2.04 EQUIPMENT ITEMS

- A. GENERAL REQUIREMENTS (see PART 2, PARAGRAPH 2.4, SECTION 27 05 11 for additional requirements): The equipment identified in this SECTION shall be the standard product(s) of an OEM regularly engaged in the manufacture of DAS and related products. All components used in the System shall be commercial quality products that comply with this document. Each component of equipment shall identify the OEM's name, model, serial number, FCC Listing and NRTL (aka UL) label or equal. The RE retains the right to reject products which reflect, in the RE's opinion, sub-standard design practices, manufacturing procedures, support services, or warranty/guarantee policies. Refer to contract drawing(s) note(s) for additional OEM information.
1. All copper cables are not required to be plenum rated if run in protective conduit and not installed "Air Plenum Areas" designated by the RE. If run outside of conduit, each fiber optic cable shall contain an inner wrap of Kynar or Teflon (or equal) plus a metal protective wrap (sometimes called 'armor') just inside the outside protective jacket.
  2. Fiber Optic Transport: are not required to be plenum rated if run in protective conduit and not installed "Air Plenum Areas" designated by the RE. When Fiber Optic Transport media is utilized; the IWS shall utilize single-mode with angle polished connectors (APC) to distribute DAS signals.
  3. Broadband (Coaxial) Distribution: When Broadband Distribution is utilized; the IWS shall use coaxial cable in the horizontal runs and passive (ie non-powered) broadband antenna(s) in the respective area(s). The coaxial cables are not required are not required to be plenum rated unless installed in designated "Air Plenum Locations."
  4. Baseband (Video and Audio) Distribution: When Baseband Distribution is utilized; the IWS shall use TWP or STP cable in the horizontal runs and passive (ie non-powered) baseband equipment to compliment the DAS in respective area(s). The baseband cables

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are not required are not required to be plenum rated unless installed in designated "Air Plenum Locations."

5. The Contractor is responsible for pricing all accessories and miscellaneous equipment required to form a complete and operating DAS system (and sub - systems) with 40% growth / expansion THAT IS BASED ON THE TOTAL NUMBER OF WIRED HORIZONTAL ANTENNA POINTS PLUS THE CAPABILITY OF ADDING AN ADDITIONAL 40% OF ANTENNA POINTS AND SUPPORT EQUIPMENT WITHOUT DISTURBING THE SYSTEM'S INFRASTRUCTURE DESCRIBED HEREIN.
  - a. The equipment quantities provided herein shall be as indicated on the drawings with the exception of the indicated spare equipment where all shall be listed on the BOM.
  - b. Each system interface point shall be provided with internal and external items to maintain a neat and orderly system of equipment and conduit connections and routing (Refer to CFM's PG-18-10 Electrical Design Manual for VA Facilities, Table 7-1 and Appendix B, Suggested Telecommunications Oneline Topology; AND OI&T Design Guide for technical assistance in identifying required Interface Point(s) and interconnecting DAS internal plant conduit requirements.
  - c. Conduit, 1.0" minimum (3/4" may be allowed on a case by case basis by the RE in writing) is required for all Life, Patient, Staff and Public Safety, Critical Service and Emergency Systems.
  - d. Equipment Functional Characteristics

<b>FUNCTIONS</b>	<b>CHARACTERISTICS</b>
Input Voltage	105 to 130 VAC
Power Line Frequency	60 Hz ±2.0 Hz
Operating Temperature	0 to 50 degrees (°) Centigrade (C)
Humidity	80 percent (%) minimum rating

6. SPECIFIC EQUIPMENT DESIGNATED BY THE DAS SYSTEM DESIGN
  - a. Antenna Equipment and Materials
    - 1) Antenna Site(s) & Installation: It is the responsibility of the Contractor to re-verify and certify each external and internal antenna installation required by the system, in writing (four [4] copies MIN), to the RE 30 days prior to construction. The Contractor is required to provide all FAA, FCC and local licenses and permits for each radio antenna item(s) requiring such licenses and permits. Additionally, at a MIN, for each external antenna site that is 75' above average ground level (AGL) or taller than appurtenances and closer buildings or objects, the Contractor shall accomplish FCC Form 854, Application for Antenna Structure Registration, FAA Advisory Circular AC 70/7460-1, Obstruction Marking and Lighting and FAA Form 7460-1, Notice of Proposed Construction and Alteration for each item requiring this registration. It is the Contractor's responsibility to contact the local licensing authority(s) to determine if the antenna installation requires additional hazard registration and accomplish all necessary documents.
    - 2) THE SYSTEM PROOF OF PERFORMANCE AND VA CERTIFICATION TESTS WILL NOT BE CONDUCTED UNTIL THESE FORMS ARE ACCOMPLISHED AND SUBMITTED TO THE APPROPRIATE FEDERAL AUTHORITIES WITH COPIES PROVIDED TO THE RE, OR VAMC CO AND VACO SMCS (005OP2H3). The Contractor shall obtain onsite technical assistance from the OEM for installation of the external antenna(s) selected during the Field Site Visit. The Contractor shall provide the RE a detailed written report of the findings of this visit for approval. The site visit and report shall be completed during the 30 days after issuance of the notice to proceed.
    - 3) Wherever possible, external antenna equipment shall be mounted so that maintenance can be accomplished without the need to climb towers, ladders,

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- cherry pickers, etc.
- 4) External Antenna Masts: Wall mounted DAS antenna mast(s) shall be rigid thick wall and have a minimum 3.0 inch (75mm) outside diameter (OD), of hot dip galvanized steel and capable of surviving MIN wind loads of 100 miles per hour (160 kilometers per hour) sustained winds with all DAS antenna equipment and mounting hardware installed, with up to 1/2 inch (12.7 mm) radial ice at the height required to provide the System performance, as described herein.
    - (a) Wall mounted external masts shall be attached to building walls, penthouse walls or other solid parts of the building exterior free of all obstructions.
    - (b) For building and penthouse walls, attach masts with not less than three (3) rust proofed brackets three (3) inches (76.2 mm) wide, 5/16 inch (7.7.9375 mm) thick, eight (8) inches (177.8254 mm) wide and spaced not less than 20 inches (508.0 mm) apart. Do not attach masts to catwalks or metal structures unless specifically approved. If allowed, masts shall be welded or bolted to the structure using an approved method of attachment. All connections shall be rustproof and painted to match the existing structure(s).
    - (c) Fasten the mounting brackets with rust proofed through bolts of a minimum 7/16 inch (11.1125 mm) diameter, each anchored with two (2 – one on the inside and one on the outside of the wall), (8 inch (203.2 mm) square, 5/16 inch (7.9375 mm) tick rust proofed steel back plates. Attachments to mortar or grout joints with lag bolts are not permitted. Securely tighten all mounting hardware, antenna hardware and terminals.
    - (d) Do not mount the mast(s) directly on the roofs of the building or penthouse unless specifically approved in writing by the RE prior to installation. Any approved roof attachment or penetration shall be resealed to prevent water leakage; using pitch pocket or other method approved by the roof OEM and Roofing Contractor.
    - (e) Do not install more than two (2) antennas on a single mast. Install separate masts, as required, with proper physical and frequency spacing between them and the antenna(s) installed. A MIN spacing shall be 1/2 wavelength ( $\lambda$ ) vertically and 5/8  $\lambda$  horizontally (element tip to element tip) for the lowest operating frequency.
    - (f) Orient the antenna(s) to insure optimum signal receive level and S/N ratio.
    - (g) Weatherproof all connections with approved sealing compound. Electrical cloth or plastic tape are not acceptable and will not be approved.
  - 5) Antenna Site Physical Protection
    - (a) External
      - (1) Roof and/or Wall Type: When an antenna is installed on a building roof or wall that is accessible from the roof, signs shall be placed on all roof access points that say "Warning, Radio Antenna Radiation Hazard." The signs shall be professionally prepared, neat and permanent. The roof area where the antenna is installed shall be painted yellow or roped off with a yellow marker tape that indicates the approximate area of RF radiation.
      - (2) Each roof or attic access for the each antenna shall be controlled by the VA Police SMS Access Control System. The Police Chief will determine the appropriate number and individual(s) that are to be granted access in these areas.
    - (b) Internal DAS: The antenna shall be placed inside a protective enclosure designed specifically for the product. The antenna shall not be visible when installed in the enclosure in the area located. DAS cables to each antenna shall be installed in protective conduit (EMT or Flex) from each Antenna Enclosure to the associated "J" Box. Each DAS Antenna Enclosure shall

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be provided with two (2) safety wires connected between each enclosure to solid building supports.

- 6) Antenna Site Lightning Protection System: Each protection system shall be provided in its entirety totally and externally to the building. The use of internal electrical or communications grounding systems is not acceptable, will not be approved; and if found during the system's proof-of-performance tests, it will be removed and the test may be terminated and rescheduled at the contractor's expense.
  - (a) Antenna, Mount & Mast: The antenna, antenna mount or mast and transmission line shall be grounded with cooper wire run external to the building and connected to the earth ground. If the antenna is to be installed in an area not protected by lightning rods or if the antenna is to be elevated above existing building's lighting rod protection, the Contractor shall immediately notify the RE in writing regarding the lightning strike hazard.
  - (b) RF Transmission Line and/or Coaxial Cable Lightning Protector: The protector shall be an in-line device equipped with screw type connectors to match the coaxial cable and dimensions specified. It shall be able to shunt high current surges to the earth ground protecting the system signal RF equipment. The protector shall have a minimal effect on the quality of the signal being received or transmitted. It shall be made of non-corrosive metal and be waterproof.

(1) Technical Characteristics

FUNCTIONS	CHARACTERISTICS
a. Peak Pulse Power	1,500 W @ 77 degrees F
b. Protection Device	Gas Tube or as required by OEM
c. Dissipation	1.0 Milliseconds (mS)
d. Response Time	5.0 nano-Seconds (nS)
e. Connectors	As Specified
f. Ground Connection(s)	The protector shall be directly mounted, by a #4 ga. MIN self taping sheet metal screw, on a MIN 5/16" (7.9375 mm) thick, 4.0" (101.6 mm) high X 22.0" (609.6 mm) Long solid copper buss grounding plate mounted directly inside and anchored to the wall at the exact coaxial cable entrance. The grounding plate shall be connected by a #0 AWG Stranded Copper Wire, MIN, or as required by the OEM, and/or the RE connected to the FACILITY'S OUTSIDE LIGHTNING PROTECTION SYSTEM.

- (2) Each lightning major ground point shall be connected with MIN #0 AWG stranded copper wire run external to the building and connected to the antenna site lightning ground described herein.

7. Antennas

- a. External: The external antenna shall be specified by the OEM for the specific system function and physical location. Acceptable designs are: ground plane fed with continuous polarization adjustment and or spread spectrum type. The antenna size, gain and beam width shall be chosen for optimum performance to meet the specified path and System reliability parameters.

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- 1) Each antenna shall be installed to meet the wind load specifications and environmental conditions.
- 2) Technical Characteristics

<b>FUNCTIONS</b>	<b>CHARACTERISTICS</b>
a. Operating Standards	As herein outlined and specified
b. Size	As required to fully satisfy system design
c. Gain	25 dB
e. Half Power Beam Width	As specified by the OEM
f. Front-to-Back Ratio (FBR)	40 dB
g. VSWR	1.15 or Less
h. RFI	None measurable
i. Wind Load Rating	40 LBS Per Square Foot (PSF) or 100 (160 kilometers) per hour

- 3) RF Transmission Line (External) - Coaxial: The provided transmission line shall be coaxial, jacketed with fire resistant material when run outside of conduit and/or cable tray, or as required by system design and described by the OEM; and, if required, pressurized to the OEM's specifications.

- (a) The cable shall be as specified by the OEM. If not specified by the OEM, it shall be provided with the proper impedance, be double shielded, and contain other characteristics to satisfy all equipment and system requirements.

(b) Technical Characteristics

(1) Outside Diameter	As specified by the OEM
(2) Center Conductor	Solid (Stranded when OEM specified) Copper, Silver Coated
(3) Outer Conductor (or Braid)	Braided Copper (solid when OEM specified) providing 100% coverage and EMI shielding
(4) Insulation	Cellular Polyethylene with air passages
(5) Jacket	Polyethylene; Teflon or Kynar (when required)

4) Attenuation:

Frequency (mHz)	Attn/dB per 100 ft (MAX)
100	2.5
200	3.5
400	5.0
890	8.0

- 5) External Antenna Feed Through: A feed through shall be provided for all Coaxial, Spiral line and/or other System wire/cable penetrations of exterior building walls or roofs. The feed through(s) shall be waterproof, sleeved, OEM recommended and RE approved.
- b. Internal: Each DAS antenna shall be specified by the OEM for the specific system function and physical location. Acceptable designs are: ground plane fed with continuous polarization adjustment and or spread spectrum type. The antenna size, gain and beam width shall be chosen for optimum performance to meet the specified path and System reliability parameters. Each antenna shall be installed to meet the local environmental (outside and inside) conditions.

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1) Environmental

FUNCTIONS	CHARACTERISTICS
(a) Application	Indoor
(b) Operating Temperature	40°C to +60°C (40°F to +140°F)
(c) Relative Humidity	Up to 100%

2) Mechanical

FUNCTIONS	CHARACTERISTICS
(a) Application	50 Ohm "N" type
(b) Mounting	Thru-hole ceiling (typical)
(c) Relative Humidity	Up to 100%
(d) Radome	Required, ABS, UV resistant
(e) Pigtail Cable	Required, plenum (if not protected) flexible with connectors installed

3) Regulatory Compliance

FUNCTIONS	CHARACTERISTICS
(a) RoHS	2002/95/EC (minimum)

- c. Omni-Directional Antenna: Omni-Directional Coverage Antenna(s) shall feature a multi-band design that accommodates multiple RF band and channels in a single unit.

1) RF Band One (1)

FUNCTIONS	CHARACTERISTICS
(1) RF Range	690 – 800 mHz
(2) VSWR	≤ 1.8:1
(3) Gain	≥ 1.5 dBi
(4) Max input power	OEM Specified
(5) Impedance	50 Ohms
(6) Beamwidth:	
(a) Vertical	80° nominal
(b) Horizontal	360° Omni-directional
(7) Return Loss	≤11 dB, maximum,
(8) RFI	None measurable
(9) Wind Load Rating:	
(a) External	40 LBS Per Square Foot (PSF) or 100 MPH
(b) Internal	Not Applicable

2) RF Band Two (2)

FUNCTIONS	CHARACTERISTICS
(1) RF Range	
(a)	710 – 2,700 mHz
(b)	800 – 950 mHz

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(2	VSWR	≤ 1.8:1
(3	Gain	
(a	≥ 1.5 dBi	800 – 950 mHz
(b	≥ 5.0 dBi	1,710 – 2,700 mHz
(4	Max input power	OEM Specified
(5	Impedance	50 Ohms
(6	Beamwidth:	
(a	Vertical	70° nominal
(b	Horizontal	360° Omni-directional
(7	Return Loss	≤14 dB, maximum,
(8	RFI	None measurable
(9	Wind Load Rating:	
(a	External	40 LBS Per Square Foot (PSF) or 100 MPH
(b	Internal	Not Applicable

3) RF Bands Three (3) and four (4):

<b>FUNCTIONS</b>		<b>CHARACTERISTICS</b>
(1	RF Range	
(a	150 – 250 mHz,	(or per OEM direction)
(b	260 – 400 mHz	(or per OEM direction)
(c	450 – 750 mHz	(or per OEM direction)
/(d	_____ mHz	(or per OEM direction)//
(2	VSWR	≤ 1.5:1 all bands
(3	Gain	
(a	≥ 1.5 dBi	150 – 750 Mhz
(b	≥ 3.0 dBi	800 mHz – 2.8 GHz (broadband)
(c	≥ 7.0 dBi	2.4 – 4.5 GHz (very broadband)
(d	≥ 18.0 dBi	3.0 – 5.7 GHz (extreme broadband)
(4	Max input power	OEM Specified
(5	Impedance	50 Ohms
(6	Beamwidth:	
(a	Vertical	70° nominal
(b	Horizontal	360° Omni-directional
(7	Return Loss	≤14 dB, maximum,
(8	RFI	None measurable
(9	Wind Load Rating:	
(a	External	40 LBS Per Square Foot (PSF) or 100 MPH
(b	Internal	Not Applicable

d. Directional Coverage Antenna(s): shall feature a multi-band design that accommodates multiple RF band and channels in a single unit.

1) RF Band One (1):

<b>FUNCTIONS</b>	<b>CHARACTERISTICS</b>
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(1 RF Range	690 – 800 mHz
(2 VSWR	≤ 1.8:1
(3 Gain	≥ 5.0 dBi
(4 Max input power	50W MAX
(5 Impedance	50 Ohms
(6 Beamwidth:	
(a Vertical	Polarization
(b Horizontal	110° nominal
(7 Return Loss	≤11 dB, maximum,
(8 RFI	None measurable
(9 Wind Load Rating:	
(a External	40 LBS Per Square Foot (PSF) or 100 MPH
(c Internal	Not Applicable

2) RF Band Two (2):

FUNCTIONS	CHARACTERISTICS
(1 RF Range	
(a	710 – 2,700 mHz
(b	800 – 950 mHz
(2 VSWR	≤ 1.5:1
(3 Gain	
(a ≥ 1.5 dBi	All channels
(4 Max input power	50W MAX
(5 Impedance	50 Ohms
(6 Beamwidth:	
(a Vertical	Polarized
(b Horizontal	90° nominal
(7 Return Loss	≤14 dB, maximum,
(8 RFI	None measurable
(9 Wind Load Rating:	
(a External	40 LBS Per Square Foot (PSF) or 100 MPH
(b Internal	Not Applicable

3) RF Bands Three (3) and four (4):

FUNCTIONS	CHARACTERISTICS
(1 RF Range	
(a 150 – 250 mHz,	(or per OEM direction)
(b 260 – 400 mHz	(or per OEM direction)
(c 450 – 750 mHz	(or per OEM direction)
(d 800 mHz – 2.8 GHz (broadband)	(or per OEM direction)
(e 2.4 – 4.5 GHz (very broadband)	(or per OEM direction)
(f 3.0 – 5.7 GHz (extreme broadband)	(or per OEM direction)
//(g _____ mHz	(or per OEM direction)//



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(2	VSWR	≤ 1.5:1 all bands (or per OEM direction)
(3	Gain	
(a	≥ 1.5 dBi	150 – 750 mHz
(b	≥ 3.0 dBi	800 mHz – 2.8 GHz (broadband)
(c	≥ 7.0 dBi	2.4 – 4.5 GHz (very broadband)
(d	≥ 18.0 dBi	3.0 – 5.7 GHz (extreme broadband)
(e	≥ 7.0 dBi	2.4 – 4.5 GHz (very broadband)
(f	≥ 3.0 dBi	800 mHz – 2.8 GHz (broadband)
(4	Max input power	50W MAX
(5	Impedance	50 Ohms
(6	Beamwidth:	
(a	Vertical	Polarized
(b	Horizontal	60 - 70° nominal
(7	Return Loss	≤14 dB, maximum,
(8	RFI	None measurable
(9	Wind Load Rating:	
(a	External	40 LBS Per Square Foot (PSF) or 100 MPH
(b	Internal	Not Applicable

8. Head End (HE) Equipment

a. DAS Equipment Room/Location

- 1) The Contractor shall confirm each HE room/location depicted on the contract drawings conforms to the MIN requirements outlined in CFM's Design Manual PG-18-10 – Chapter 7 and OI&T Design (a copy can be obtained from the RE or SMCS [005OP2H3]).
- 2) Any noted deviation(s) shall be provided to the RE in writing for an official determination concerning each noted item and how it/they will affect the system.
- 3) The RE shall contact SMCS (005OP2H3) for technical assistance and the A/E for structural assistance.

B. CABINET WITH INTERNAL EQUIPMENT MOUNTING RAIL(S)(DO NOT DELETE): shall be lockable, fabricated of heavy 16 gauge (ga) steel, and have fully adjustable internal equipment mounting racks and/or rails that allows front panel equipment mounting and access.

1. Each equipment mounting rail shall be able to provide an internal cabinet ground for each installed equipment when the equipment is properly bolted to the rail.
2. Additionally, connect each equipment grounding terminal to a separate mounting hole on the equipment mounting rail to the right as one looks at it from the rear with a minim #12 AWG stranded copper wire with protective jacket.
3. It shall have baked-on iron phosphate primer and baked enamel paint finish in a color to be selected by the RE or FMS Service Chief.
4. It shall be floor or wall mounted with knock-out holes for cable entrance(s) and conduit connections, contain ventilation ports and a quiet fan with non disposable air filter for equipment cooling.
5. Each cabinet shall be keyed alike and four (4) keys shall be provided to the RE for each 10 cabinets used when the VA accepts the System.
6. A minimum of one (1) cabinet shall be provided with blank rack space, for additional expansion equipment. Blank panels shall be installed to cover any open or unused rack space. In addition, provide two (2) 120 VAC power strips connected to surge protector(s), a ventilation fan with non-disposable air filter, and a conduit or cable duct interfaced to

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adjacent cabinet(s) and local room wire management system, as part of this cabinet.

- a. Blank panels shall be color matched to the cabinet, 1/8in. (3.175 mm) thick aluminum with vertical dimensions in increments of one rack unit (RU) or 1.75in. (44.8469 mm) with mounting holes spaced to correspond to EIA 19in. (482.6 mm) rack dimensions.
  - b. Single standard larger size blank panels shall be used to fill unused panel or rack spaces in lieu of numerous types. One blank 1.75in. (44.8469 mm) high blank panel shall be installed between each item of equipment.
7. Provide internal cabinet communications grounding system and connect to communications ground buss bar with a minimum #6 AWG stranded copper wire with protective covering (see PART 2, PARAGRAPH 2.4.B).
- a. Each cabinet shall be grounded to the communications grounding system.
  - b. Connect the communications system grounding wire to a cabinet provided ground terminal or with a bolt(s) screwed into one mounting hole of each equipment mounting rail (refer to PARAGRAPH 2.9 HEREIN).

8. Technical Characteristics

Overall Height	2,180 mm (85 7/8in.), maximum
Overall Depth	650 mm (25 1/2in.), maximum
Overall Width	535 mm (21 1/16in.), maximum
Front Panel Opening Width	480 mm (19in.), EIA horizontal
Hole Spacing	per EIA and Industry Standards

9. Internal Cabinet Components (MINIMUM REQUIRED)

- a. AC power outlet strips:
  - 1) Two (2) Power outlet strips shall be provided as directed by the OEM. The additional spare equipment cabinet with no installed items in the cabinet shall contain two (2) AC strips with a minimum of 10 ea. AC power outlets. Each strip shall be mounted inside and at the rear of the cabinet. It shall contain "U" grounded AC outlets for distributing AC power to the installed electronic equipment. The strip shall be self-contained in a metal enclosure and may be provided with a 2 M (6 ft.) long (maximum) connecting cord with three prong plug.
  - 2) Technical Characteristics:
    - (a) Power capacity 20 Ampere (AMP), 120 VAC continuous duty.
    - (b) Wire gauge: Three conductor, #12 AWG copper.
- b. Cabinet AC Power Line Surge Protector and Filter:
  - 1) Each cabinet shall be equipped with a AC Surge Protector and Line Filter. The Protector and Filter shall be housed in one single enclosure. The Protector and Filter shall perform instantaneous regulation of the AC input voltage and isolate and filter any noise present on the AC input line. The unit shall be equipped with AC voltage and current surge protectors to prevent damage to the electronic equipment from power line induced voltage spikes, surges, lightning, etc. It shall be cabinet mounted and the cabinet AC power strip (maximum of two [2] strips) may be connected to it as long as the system design is met.

2) Technical Characteristics

Input Voltage range	120 VAC + 15%
Power capacity	20 AMP, 120 VAC
Voltage output regulation	+3.0%
Circuit breaker	15 AMP, may be self contain
Noise filtering	Greater than -45 dB
AC outlets	Four (4) duplex grounded types, minimum
Response time	5.0 ns

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Suppression	
Surge	10,000 A
Noise	
Common	-40 dB
Differential	-45 dB

- 3) Specific requirements for current and surge protection shall include:
- (a) Voltage protection threshold, line to neutral, starts at no more than 220 Volts peak. The transient voltage shall not exceed 300 volts peak. The Contractor shall furnish documentation on peak clamping voltage as a function of transient AMP.
  - (b) Peak power dissipation minimum 35 Joules per phase, as measured for 1.0 mS at sub branch panels, 100 Joules per phase at branch panels and 300 Joules per phase at service entrance panels. The Contractor shall furnish an explanation of how the ratings were measured or empirically derived.
  - (c) Surge protector must not short circuit the AC power line at any time.
    - (1) The primary surge protection components must be silicon semiconductors. Secondary stages, if used, may include other types of devices.
    - (2) Surge protectors shall incorporate a visual device which indicates whether the surge suppression component(s) is (are) functioning.
    - (3) Surge protection devices shall be UL listed.
    - (4) Voltage and current surge protectors shall be provided on all ancillary equipment provided by the Contractor.
  - (d) Power dissipation 12,000 Watts (W) for 1.0 mS (or 12 Joules).
  - (e) Voltage protection threshold starts at not more than 100 VAC.
- c. Uninterruptible Power Supply (UPS): Each cabinet shall be provided with an internal UPS. This item may be combined with the Surge Protector & Filter in PART 2, PARAGRAPH 2.4.1.8.b as long as the 50% expansion is met. The UPS shall provide at least one (1) hours continuous full load //two hours if working with an emergency / safety system// uninterruptible system primary AC Power, with a 25% (at least one //to two hours//) reserve capacity, in the event of Facility Primary or Emergency AC Power failure.

- 1) The UPS shall include, but not be limited to:

a) Protection switch	Required to automatically protect the UPS unit and associated equipment connected to it. This function is required to be a part of the System's electronic supervision requirements.
b) First/fast charge unit	Must provide clean predicable charge voltage / current when needed. This function is required to be a part of the System's electronic supervision requirements.
c) Over Voltage/Current protect	Must not short circuit the AC power line at any time. This function is required to be a part of the System's electronic supervision requirements.
d) Trickle charge unit	Must be cable of maintaining a suitable internal battery charge without damaging the batteries.

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e)	Internally mounted	Per OEM's direction.
f)	Proper ventilation	Not override the cabinets' ventilation system.
g)	Power change from AC input	Shall be accomplished without interruption to the communications link or subsystem being protected. This change of state shall generate visual and aural alarms in its Electrical Supervision System.
h)	Electrical supervision	Required – must be audible and visual locally and remotely to annunciating panel(s) via direct connection for trouble indication

C. ENVIRONMENTAL CABINET (if selected): The Contractor shall provide this enclosure in lieu of a standard equipment cabinet identified in Paragraph 2.4.B to meet system design in hostile TR locations as identified in CFM's OI&T Design Guide and locations as shown on the drawings.

1. The enclosure shall fully sustain the installed, including electronic, equipment in the same manner as the standard cabinet identified in Paragraph 2.4.B. Additionally, the enclosure shall fully support all installed equipment as if they were in a standalone air handling area regardless of the local area's air handling capabilities.
2. The enclosure shall be an OEM's fully assembled unit.
3. If more than two enclosures are required in any system location, those enclosures shall be OEM assembled for consolidating or combining two or more enclosures in a single unit to meet system space and equipment handling designs plus maintain OSHA spacing requirements.
4. Technical Characteristics

a.	Environmental control	Automatic, heating and/or cooling, as required
b.	Temperature conditions (rated at 1,300 W of install equipment heat generation):	
c.	Internal Range	Maintains 80° to 105° of internal heat conditions, maximum
d.	External Range	100° + 25°, maximum
e.	Forced air unit	Required with non disposable air filter unobstructed and uninterruptible
f.	Air conditioning	As required, fully internal mounted
g.	Heater	As required, fully internal mounted
h.	Uninterruptible power supply	As required, fully internal mounted
i.	Front door	Full length, see through, EMI resistant, and lockable
j.	Rear door	Full length, non-see through, EMI resistant, and lockable
k.	Conduit wiring entrance	Top and/or bottom, fully sealed
l.	Input power	2 ea. minimum 120 VAC @ 20A, maximum, independent circuit, conduit for fixed or armored cable for moveable installations
m.	Dimensions:	
n.	Height	1980 mm (78in.), maximum
o.	Width	635 mm (25in.), maximum

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p.	Depth	965 mm (38in.), maximum
q.	Front panel opening	480 mm (19in.), w/ EIA mounting hole spacing

D. DISTRIBUTION OR SYSTEM INTERFACE CABINET: The cabinet shall be constructed of heavy 16 ga cold rolled steel, have top and side panels and hinged front and rear (front door only if wall mounted) doors.

1. It shall have baked-on iron phosphate primer and baked enamel paint finish in a color to be selected by the using FMS Chief or the RE, contain integral and adjustable predrilled rack mounting rails or frame that allows front panel equipment mounting and access.
2. When all equipment, doors and panels are installed, snap-in-place chrome trim strip covers are required to be installed that will cover all front panel screw fasteners.
3. It shall be equipped the same as the equipment cabinet.
4. Technical Characteristics

a.	Overall height	2,180 mm (85 7/8in.), maximum
b.	Overall depth	650 mm (25 1/2in.), maximum
c.	Overall width	535 mm (21 1/16in.), maximum
d.	Equipment vertical mounting space	1,960 mm (77 1/8in.), maximum
e.	Front panel horizontal	484 mm (19 1/16in.), maximum width

E. STAND ALONE EQUIPMENT RACK (or sometimes called Radio Relay Rack): The rack shall be constructed of heavy 16 ga cold rolled steel and have fully adjustable equipment front mounting rails that allows front panel equipment mounting and access.

1. It shall have baked-on iron phosphate primer and baked enamel paint finish in a color to be selected by the using FMS Chief or the RE. It shall be floor or wall mounted or mounted on casters as directed by the RE.
2. Technical Characteristics

a.	Overall Height	2,180 mm (85 7/8in.), maximum
b.	Overall Depth	650 mm (25 1/2in.), maximum
c.	Overall Width	535 mm (21 1/16in.), maximum
d.	Front Panel Opening	480 mm (19in.), EIA horizontal width
e.	Hole Spacing	per EIA and Industry Standards

F. WIRES AND CABLES

1. CONTROL WIRING: Is not required to be plenum rated when installed in conduit. It is required to be plenum rated when installed in designated "Air Plenum" spaces / areas. Wiring that is routed in cable trays via pathways that is not rated "Air Plenum" locations, the wiring is not required to be plenum rated; only when pathways pass through "Air Plenum" spaces/areas, the wiring shall be plenum rated.
  - a. Unless otherwise specified in other Specifications Sections of the TIP specifications (re SECTIONS 27 05 11, 27 11 00, 27 13 00 & 27 15 00), control wiring shall be as specified for power and lighting wiring, except the minimum size shall be not less than No. 16 AWG.
  - b. Control wiring shall be large enough so that the voltage drop under "turn-on" conditions does not adversely affect operation of the controls.
2. COMMUNICATIONS AND SIGNAL WIRING: Is not required to be plenum rated when installed in conduit. It is required to be plenum rated when installed in designated "Air Plenum" spaces / areas. Wiring that is routed in cable trays via pathways that is not rated "Air Plenum" locations, the wiring is not required to be plenum rated; only when pathways pass through "Air Plenum" spaces/areas, the wiring shall be plenum rated. The wires:
  - a. Shall conform to the recommendations of the OEMs of the communication and signal systems; however, not less than what is shown.
  - b. Shown is for typical systems. Provide wiring as required for the systems being furnished.

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- c. Multi-conductor construction shall have the conductors color coded per TIA/TIA 569.
  - d. Shall provide minimum grade of service of BICSI Category 5E. If the Facility desires enhanced grade(s) of service, it must be fully identified and justified at the beginning of the project, during the Project's initial design phase.
3. COPPER CONDUCTOR CABLE: Is defined as solid copper conductors, covered with an extruded solid insulating compound. Insulated conductors shall be twisted into pairs which are then stranded or oscillated to form a cylindrical core. The copper cable is not required to be plenum rated when installed in conduit. It is required to be plenum rated when installed in designated "Air Plenum" spaces / areas. Wiring that is routed in cable trays via pathways that is not rated "Air Plenum" locations, the wiring is not required to be plenum rated; only when pathways pass through "Air Plenum" spaces/areas, the wiring shall be plenum rated.
- a. For special high frequency applications, the cable core shall be separated into compartments.
  - b. Cable shall be completed by the application of a:
    - 1) Suitable core wrapping material,
    - 2) Corrugated copper or plastic coated aluminum shield, and
    - 3) Overall extruded jacket.
  - c. The contractor shall verify distances between splice points prior to ordering cable in specific cut lengths. Gauge of conductor shall determine the range of numbers of pairs specified (ie):
    - 1) 19 gauge (6 to 400 pairs),
    - 2) 22 gauge (6 to 1,200 pairs),
    - 3) 24 gauge (6 to 2,100 pairs),
    - 4) 26 gauge (6 to 3,000 pairs).
  - d. Each copper cable shall meet or exceed the following specifications for the specific type of cable:
    - 1) Each cable reel shall be sweep tested and certified by the OEM by tags affixed to each reel. The Contractor shall turn over all sweep tags to the RE or PM. Additionally, the Contractor shall provide a 610 mm (2 ft.) sample of each provided cable, to the RE and receive approval before installation.
    - 2) Cables installed in any outside location (i.e. above ground, underground in conduit, ducts, pathways, etc.) shall be filled with a waterproofing compound between outside jacket (not immediately touching any provided armor) and inter conductors to seal punctures in the jacket and protect the conductors from moisture.
    - 3) The Contractor shall provide all Systems cables that are OEM recommended and insure the approved System expansion is met.
  - e. Data Multi-Conductor (Digital): The cable shall be multi-conductor, shielded or unshielded cable with stranded conductors. The cable shall be able to handle the power and voltage used over the distance required.
    - 1) It shall meet BICSI Category 5e service at a minimum.
    - 2) Technical Characteristics:

REQUIREMENT	FUNCTION
a) Wire size	22 AWG, minimum
b) Working shield	350 V
c) Bend radius	10X the cable outside diameter
d) Impedance	100 Ohms + 15%, BAL
e) Bandwidth	100 mHz, minimum
f) dc resistance	10.0 Ohms/100M, maximum
g) Shield coverage	

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h) Overall Outside (if OEM specified)	100%
i) Individual Pairs (if OEM specified)	100%
j) Attenuation	
k) Frequency in mHz	dB per 305 M (1,000ft.), maximum
0.7	5.2
1.0	6.5
4.0	14.0
8.0	19.0
16.0	26.0
20.0	29.0
25.0	33.0
31.0	36.0
62.0	52.0
100.0	68.0

- f. Remote Control: The remote control cable shall be multi-conductor with stranded (solid is permissible) conductors.
- 1) The cable shall be able to handle the power and voltage necessary to control specified system equipment from a remote location.
  - 2) The cable shall be NRTL listed and pass the FR-1 vertical flame test, at a minimum.
  - 3) Each conductor shall be color-coded.
  - 4) Combined multi-conductor and coaxial cables are acceptable for this installation, as long as all system performance standards are met.
  - 5) Technical Characteristics

REQUIREMENT	FUNCTION
a) Length	As required, in 1K (3,000 m.) reels minimum
b) Connectors	As required by system design
c) Size	18 AWG, minimum, Outside 20 AWG, minimum, Inside
d) Color coding	Required, EIA industry standard
f) Bend radius	10X the cable outside diameter
g) Impedance	As required
h) Shield coverage	As required by OEM specification
i) Attenuation	
j) Frequency in mHz	dB per 305 M (1,000ft.), maximum
0.7	5.2
1.0	6.5
4.0	14.0
8.0	19.0
16.0	26.0
20.0	29.0
25.0	33.0

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31.0	36.0
50.0	52.0

4. FIBER OPTIC CABLE: Is not required to be plenum rated when installed in conduit. It is required to be plenum rated when installed in designated "Air Plenum" spaces / areas. Wiring that is routed in cable trays via pathways that is not rated "Air Plenum" locations, the wiring is not required to be plenum rated; only when pathways pass through "Air Plenum" spaces/areas, the wiring shall be plenum rated.
- a. Single-mode
    - 1) 8/125-um, 0.10 aperture 1,310 nm fiber optic cable in accordance with TIA-492CAAA,
    - 2) 8/125-um, 0.10 aperture 1,550 nm fiber optic cable in accordance with TIA-492E000.
  - b. Multimode
    - 1) 62.5/125-um, Bell System Standard, 0.275 aperture fiber optic cable in accordance with TIA-492AAAA, TIA-472D000, and ICEA S-87-640, OR
    - 2) 50/125-um, American (NOT EUROPEAN) Standard, 0.275 aperture fiber optic cable that is optically enhanced in accordance with TIA-492AAAB, including any special requirements made necessary by using this specialized design (re PART 1, PARAGRAPH 1.4.E.3.h for minimum performance).
  - c. Strength Members: Provide //central// //non-central//, //non-metallic// //metallic// strength members with sufficient tensile strength for installation and residual rated loads to meet the applicable performance requirements in accordance with ICEA S-87-640. The strength member is included to serve as a cable core foundation to reduce strain on the fibers, and shall not serve as a pulling strength member.
  - d. Shielding or Other Metallic Covering: Provide //copper//, //copper alloy// //copper and steel laminate// //copper and stainless steel// //coated stainless steel// //bare low carbon steel// //bare aluminum or coated aluminum// //single// //dual// tape covering or shield// in accordance with ICEA S-87-640.
  - e. Fiber optic cable: Shall be specifically designed for inside or outside use with loose buffered construction. Provide fiber optic color code in accordance with TIA/EIA-598.
  - f. Performance Requirements: Provide fiber optic cable with optical and mechanical performance requirements in accordance with ICEA S-87-640.
    - 1) End to End Link Performance as listed in Annex E of ANSI/ TIA/ EIA SP-2840A.
    - 2) The cabling system must conform to the current issue of Industry Standard ANSI/TIA/EIA 568A.
    - 3) The system shall support all applications for which it is designed, including, at a minimum ATM 155 Mbps for BICSI Certified Category 5E (see PART 2, PARAGRAPH 2.4.C.4), during the lifetime of the certified system.
    - 4) Quality and installation methods used shall be equal to or better than that found in the BICSI TDM Manual.
    - 5) VA demands strict adherence to the performance specifications listed in ANSI/TIA/EIA SP-2840A, 568A and 569.
    - 6) New construction AND major renovations of telecommunications spaces and pathways shall conform to EIA/TIA 569, at a minimum.
      - (a) In cases of renovations in historic or otherwise restrictive buildings; where it has been determined as impossible to follow the above stated guidelines, the exceptions must not modify the maximum distances set forth in ANSI/TIA/EIA SP-2840A, 568A and 569 and must not in any way affect the performance of the entire cabling system.
      - (b) Modification to administrative issues requires written approval(s) from CFM's PE/ PM and/or RE; with concurrence from the OEM, Contractor, SMCS and Using Authority(s).



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- G. TEMPORARY DAS TIP PATHS: (ie overhead tracks, road / path bridges, etc.) for copper, fiberoptic, RF, coaxial and designated electrical cables that are used to maintain Facility Communications Service in force during construction and shall be installed so as to not present a pedestrian and traffic (including construction) safety hazard.
1. TIP temporary cable installations are not required to meet Industry Standards; but, each must be reviewed and approved, in writing, by the RE with concurrences from SMCS 005OP2H3, the Facility OI&T and Safety Officer, prior to installation. The Contractor shall:
    - a. Be responsible for all work associated with each temporary TIP path installation required by system design; and, for its/their removal when determined no longer necessary,
    - b. Survey the outside TIP locations usually encountered, but are not limited to: Roads, driveways, marked paths, Hi traffic passageways, personnel walkways, etc, and provide the RE a plan for the temporary path, and
    - c. Ensure each temporary TIP path is installed so as to not present a pedestrian and vehicle safety hazard.

- H. DAS CROSS-CONNECTION SYSTEM (CCS) EQUIPMENT BREAKOUT, TERMINATION CONNECTOR (OR BULKHEAD), AND PATCH PANELS (ARE IN ADDITION TO THE TIP CCS REQUIREMENTS): Each DAS CCS requires the use of a single tool, has the fewest amount of parts, and the least amount of assembly or projected trouble shooting time during the life of the system.

1. The CCS system used at each ENT (aka DEMARC), TER & MCR, MCOR, PCR, ECR, SCC, HER, STR's, TR's. The IDF shall force cross-connect cable slack management through adherence to the OEM's installation methods, provided cable management systems, and as described herein, so that moves, adds, and changes can be administered easily and cost effectively.
2. The connector panel(s) shall be made of flat smooth 3.175 mm (1/8 in.) thick solid aluminum, custom designed, fitted and installed in the cabinet. Bulkhead equipment connectors shall be mounted on the panel to enable all cabinet equipment's signal, control, and coaxial cables to be connected through the panel. Each panel shall be color matched to the cabinet installed.
3. Voice (or Telephone): The DAS CSS for voice or telephone service shall be Bell/ATT Telephone Industry Standard rated 110A (minimum) punch blocks for voice or telephone, and control wiring in lieu of patch panels, each being certified for BISC1 Category 5E service.
  - a. IDC punch blocks (with internal RJ45 jacks) are acceptable for use in all DAS CCS and shall be specifically designed for BISC1 Category 5E telecommunications service and the size and type of UTP cable used as described herein.
  - b. Punch block strips shall be secured to an OEM designed physical anchoring unit on a wall location in the DEMARC, MCR, TER, STRs, TRs & HER's DAS Vertical Cross Connection System (VCCS) & Horizontal Cross Connection System (HCCS) ARE IN ADDITION TO RIP V&HCCS REQUIREMENTS.
  - c. Console, cabinet, rail, panel, etc. mounting is allowed at the OEM recommendation and as approved by the RE.
  - d. Punch blocks shall not be used for Class II or 120 VAC power wiring.
  - e. Technical Characteristics

Horizontal rows	100, minimum
Terminals per row	4, minimum
Terminal protector	required for each used or unused terminal
Insulation splicing	required between each row of terminals
Wire management	Required, internal
Spares	25% circuit capacity by extra rows or punch blocks

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4. Digital (or High Speed Data): The DAS CCS shall be a patch panel with modular female RJ45 jacks installed in rows.
- Patch panels and RJ45 jacks shall be specifically designed for BISCII Category 5E telecommunications service and the size and type of UTP or STP cable used.
  - Each panel shall be 480 mm (19in.) horizontal EIA rack mountable dimensions with EIA standard spaced vertical mounting holes.
  - Technical Characteristics

Horizontal rows	2 or 4, minimum
Jacks per row	24, minimum
Type of jacks	RJ45, female
Terminal protector	required for each used or unused jack
Insulation	required between each row of jacks
Product Reference	Ortronics Mdl. OR-B51004983 for four rows and OR-S51004912 for two rows, or equal
Wire management	Required, internal
Spares	25% circuit expansion jacks or extra jack panel(s)

5. Fiber Optic Distribution Panel (aka Light Wave Shelf) The panel shall be provided with pre-punched chassis mounting holes, contained in a metal enclosure with lockable & tinted see-thru protection cover.

- This panel is not allowed to be used for 120 VAC power connections.

- Technical Characteristics

Height	4 rack units (RUs), 176 mm (7.0 in.)
Width	484 mm (19 1/16in.), EIA minimum
Horizontal Rows	6 ea, minimum
Vertical Rows	12 ea, minimum
Total Connectors	72 ea, minimum
Connector Type	AT&T/Bell Standard "ST" female, or equal
Produce Reference	AT&T LST1U-072/7, or equal
Wire management	Required, internal
Spares	25% circuit expansion jacks or extra jack panel(s)

6. Mounting Strips and Blocks

- Barrier Strips: Barrier strips are approved for AC power, data, voice, and control cable or wires. Barrier strips shall accommodate the size and type of audio spade (or fork type) lugs used with insulating and separating strips between the terminals for securing separate wires in a neat and orderly fashion. Each cable or wire end shall be provided with an audio spade lug, which is connected to an individual screw terminal on the barrier strip. The barrier strips shall be surface secured to a console, cabinet, rail, panel, etc. 120 VAC power wires shall not be connected to signal barrier strips.

- Technical Characteristics

Terminal size	6-32, minimum
Terminal Count	Any combination
Wire size	20 AWG, minimum
Voltage handling	100 V, minimum
Protective connector cover	Required for Class II and 120 VAC power

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	connections
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7. Solderless Connectors: The connectors (or fork connectors) shall be crimp-on insulated lug to fit a 6-32 minimum screw terminal. The fork connector shall be installed using a standard lug-crimping tool.
8. Punch Blocks: As a minimum, Bell/AT&T Industry Standard 110A type punch blocks are approved for data, voice, and control wiring. Punch blocks shall be specifically designed for the size and type of wire used. Punch block strips shall be secured to a console, cabinet, rail, panel, etc. Punch blocks shall not be used for Class II or 120 VAC power wiring.
9. Wire Wrap Strips: Industry Standard wire wrap strips (16.5 mm (0.065in.) wire wrap minimum) are approved for data, voice and control wiring. Wire wrap strips shall be secured to a cabinet, rail, panel, etc. Wire wrap strips shall not be used for Class II or 120 VAC power wiring.
10. Analog Audio or Control System: Product reference of a Government Approved (US State Department) type is Telewire, PUP-17 with pre-punched chassis mounting holes arranged in two horizontal rows.
  - a. This panel may be used for audio, control cable, and Class II Low Voltage Wiring installations when provided with the proper connectors.
  - b. This panel is not allowed to be used for 120 VAC power connections.
  - c. Technical Characteristics

Height	Two rack units (RUs), 88 mm (3.5in.) minimum
Width	484 mm (19 1/16in.), EIA minimum
Number of connections	12 pairs, minimum
Connectors	
Audio Service	Use RCA 6.35 mm (1/4in.) Phono, XL or Barrier Strips, surface mounted with spade lugs (punch block or wire wrap type strips are acceptable alternates for barrier strips as long as system design is maintained and RE approved)
Control Signal Service	Barrier strips surface mounted with spade lugs (punch block or wire wrap type strips are acceptable alternates for barrier strips as long as system design is maintained and RE approved)
Low voltage power (class II)	Barrier strips with spade lugs and clear full length plastic cover, surfaced mounted
Fiber optic	"ST" Stainless steel, female

- I. TELECOMMUNICATIONS OUTLETS (TCO): Is the final outlet/connector for the interface between the horizontal wiring and the designated room/area TCO locations. The Contractor shall clearly and fully indicate this category for each TCO location and compare the total count to the locations identified herein as a part of the technical submittal. Additionally, the Contractor shall indicate the total number of spares.
  1. The System shall be capable of receiving the specified telephone (or voice) and data signals acquired from the LEC, FTS contracted carrier and computer system, and \_\_\_\_\_ each RF coaxial cable(s) and \_\_\_\_\_ each fiber optic single mode and multimode cable(s) and shall process and distribute them to the designated TCO's described herein and as shown on the drawings.

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2. Each designated room/area shall be supplied with a TCO outlet/ connector (aka modular jack or RJ-45) for connection to the TIP Horizontal Cable Plant. All TCO outlet/connectors shall be installed in an appropriate faceplate designated by the OEM. All TCO outlet/connectors shall be complete with faceplate and attached permanently to a fixed structure, such as building walls, utility poles or modular furniture partitions.
3. The TCO shall be modular in construction and able to accept six (6) modular connection jacks mounted in a separate 100mm (4in.) x 100mm (4in.) x 63mm (2.5in.) steel outlet box with a labeled six (6) position modular faceplate.
4. The TCO Eight (8) position modular outlet/connectors (aka RJ45 jacks) shall accept six (6) position modular plugs (RJ1 1 or RJ1/2) while providing proper electrical connection and not damaging the jack. The OEM shall warrant all eight (8) position modular jack used in such a manner to be usable for 8 position modular plugs in the future.
5. The TCO shall be activated with one (1) minimum 25 //and \_\_\_\_\_// pair UTP cable that will sustain minimum BICSI Category 5e communications service punched down or connected to the respective TR HCCS (label each wire at each end and coil and tape unused wires in the TCO outlet box back) to contain two (2) RJ-45/11 telephone multipin jacks and two (2) RJ-45 data multipin //, and one single mode fiber optic //, and one multimode fiber optic //, and one baseband RF, video, or audio (not Telephone) // jacks that are connected to the respective HCCS. The:
  - a. Top two (2) jacks shall be designated for telephone (voice) service,
  - b. Middle two (2) designated for data service,
  - c. Bottom two (2) // and two fiber optic "ST" connectors, one designated for multimode fiber optic cable and the other for single mode fiber optic cable connection(s) // // and one analog RF coaxial "F" connector. //
6. A second 100mm (4in.) x 100mm (4in.) x 63mm (2.5in.) steel outlet box with a stainless steel or color matched faceplate shall be provided adjacent to and attached to the activated outlet box for system expansion.
7. In order to allow normal expansion of service during the life of the TIP system, flush work area TCOs shall provide sufficient density to support up to a maximum of:
  - a. Eight (8) jacks/ connectors per single gang TCO,
  - b. Twelve (12) jacks/connectors per double gang TCO, and
  - c. Surface mount TCO's shall provide up to six (6) jacks/ connectors.
8. A non-impact termination method using a full-cycle terminating tool-having exhibiting both tactile and audible feedback to indicate proper termination shall be used. High impact tools are not acceptable and will not be approved. Terminated conductor ends shall be properly trimmed to assure a minimum clearance of 0.250 in. between the conductors of adjacent modules.
9. TCO face plates shall be clean in appearance and OEM recommended for the service it's performing. Mounting hard-ware shall not be visible on the faceplate. Color coded modules shall be employed, and colors shall comply with the requirements of EIA/TIA 606.
10. The room/area TCO outlet/connectors shall not cause or create "resonance" on short cable runs as described in the Field Testing TSB 67 (Draft 13 section 7.8 Short Links/Channels).
11. Each TCO outlet/connector shall require (or specifically not allow more than) only one single connection to the TIP Horizontal Cable serving its location as per TIA/EIA 568/568A standard.
12. Flush mounted TCO faceplates shall accommodate modular TCO outlet/connectors and be available in one (1), two (2), four (4), six (6) and eight (8) connectors per single gang TCO.
  - a. The modular TCO outlet/connectors available shall include a minimum of four active (4) UTP eight (8) position (RJ-45), one inactive (1) optical fiber in //SC// //ST// terminations, one future (1) "F" OR one (1)"BNC" connectors for coax and video service respectively and one (1) "Spare" unused space.
  - b. All TCO's shall be made of OEM approved high impact plastic.

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13. The same modular TCO outlet/connectors as found in the flush and surface mount TCOs shall be installable in utility poles and modular furniture using OEM faceplates or adapters for this purpose. Each TCO shall house at least four (4) active TCO modular RJ-45 outlet/connectors.
14. The same modular TCO outlet/connectors as found in the flush and surface telecommunications outlets shall be installable in readily available single gang and double gang stainless steel faceplates using OEM faceplates or adapters for this purpose. The eight (8) position modular UTP TCO outlet/connector and its pin assignments shall meet the requirements described in the standard TIA/EIA 568A.
15. Each TCO shall be uniquely labeled as described herein. The label shall form an integral part of the faceplate.
16. For PBPU installations, the cover plate shall be the unit's OEM approved.
17. Each TCO with appropriate jacks installed shall be provided by the Contractor in each designated location and as shown on the drawings.
  - a. If the TCO's are not shown on the drawings, at a minimum, one (1) TCO shall be provided on each room wall, associated with an active 120 VAC duplex outlet shall be provided.
  - b. The contractor shall provide a minimum of one spare TCO per 25% of the total system count (whichever is greater) to the RE as System Expansion/Maintenance items.
18. TCO Connection (aka Patch) Cables
  - a. Telephone (aka voice): The Contractor shall provide one (1) voice connection (Patch) cable for each TCO telephone jack and HCCS Patch Panel (if provided by system design) in the System with 15% spares.
  - b. The telephone (voice) connection cable shall connect the telephone instrument to one of the TCO telephone (voice) jacks. The Contractor shall not provide telephone instrument(s) or equipment.
  - c. Technical Characteristics
 

Length	1.8M (6ft.), minimum
Cable	Voice Grade
Connector	RJ-11/45 compatible male on each end
Size	24 AWG, minimum
Color coding	Required, telephone industry standard
  - d. Data (aka Digital): The Contractor shall provide one (1) data connection cable for each DAS TCO data jack and CCS patch panel in the system with 15% spares.
    - 1) The data connection cable shall connect a data instrument to the TCO data jack and perform data signal interconnection on the CCS patch panel. DAS TCOs ARE IN ADDITION TO THE TIP REQUIRED TCOs.
    - 2) The Contractor shall not provide active data terminal(s)/ equipment.
    - 3) Technical Characteristics
 

Length	1.8M (6 ft.), minimum
Cable	Data grade Category Six
Connector	RJ-45 male on each end
Color coding	Required, data industry standard
Size	24 AWG, minimum
  - e. Fiber Optic: The Contractor shall provide one (1) fiberoptic connection cable for each DAS TCO fiber optic jack and CCS patch panel in the System with 15% spares.
    - 1) The connection cable shall connect a fiber optic instrument to the DAS TCO fiber optic jack and perform voice, data or HDTV interconnection on the CCS patch panel. The Contractor shall not provide fiber optic instrument(s)/equipment.

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2) Technical Characteristics

Length	1.8M (6 ft.), minimum
Cable	Flexible single conductor with jacket
Connector	ST male on each end
Size	To fit single mode or multimode cable

f. RF: The Contractor shall provide one (1) RF coaxial cable connection cable for each DAS TCO RF connector and CCS patch panel in the System with 1 5% spares.

1) The RF coaxial connection cable shall connect a RF instrument to the DAS TCO RF jack and perform HDTV signal interconnection on the HCCS patch panel (if provided).

2) Technical Characteristics

Length	1.8M (6 ft.), minimum
Cable	Flexible RG-6/U, minimum
Connector	"F" male on each end //

g. Baseband / Video: The Contractor shall provide one (1) coaxial connection cable for each TCO baseband / video jack and HCCS patch panel in the System with 15% spares. The coaxial video connection cable shall connect a baseband / video instrument to the TCO analog video jack and perform signal interconnection on the CCS patch panel (if provided). The Contractor shall not provide baseband / video instrument(s)/equipment.

1) Technical Characteristics:

Length	1.8M (6 ft.), minimum
Cable	Flexible RG-59/U, minimum
Connector	BNC male on each end //

h. Baseband Audio: The Contractor shall provide one (1) audio connection cable for each TCO analog audio jack and HCCS patch panel in the System with 15% spares.

1) The audio connection cable shall connect an audio instrument to the TCO analog audio jack and perform signal interconnection on the HCCS panel (if provided).

2) The Contractor shall not provide active analog audio instrument(s)/equipment.

3) Technical Characteristics

Length	1.8M (6 ft.), minimum
Cable	Flexible 22 AWG, STP, minimum
Connector	"XL" male on each end//

J. COMMON EQUIPMENT ITEMS

1. Conduits

a.	Rigid galvanized steel	Shall Conform to UL 6, ANSI C80.1.
b.	Rigid aluminum	Shall Conform to UL 6A, ANSI C80.5.
c.	Rigid intermediate steel (IMC)	Shall Conform to UL 1242, ANSI C80.6.
d.	EMT	Shall Conform to UL 797, ANSI C80.3. Maximum size not to exceed 105 mm (4 inch) and shall be permitted only with cable rated 600 volts or less.
e.	Flexible galvanized steel	Shall Conform to UL 1.
f.	Liquid-tight flexible metal	Shall Conform to UL 360.
g.	Direct burial plastic	Shall conform to UL 651 and UL 651A, and heavy wall PVC or high density

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	polyethylene (PE).
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2. Conduit Fittings

a. Rigid steel and IMC	
(1) Fittings	Shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
(a) Sealing	Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.
(2) Standard threaded couplings, locknuts, bushings, and elbows	Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
(3) Locknuts	Bonding type with sharp edges for digging into the metal wall of an enclosure.
(4) Bushings	Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
(5) Erickson (union-type) and set screw type couplings	Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
(6)	Must be OEM approved.
b. EMT	Shall meet the requirements of UL 514B and ANSI/ NEMA FB1
(1) fittings	Only steel or malleable iron materials are acceptable.
(2) Couplings and connectors	Concrete tight and rain tight, with connectors having insulated throats. Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller. Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches). Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.

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(3)		Must be OEM approved.
c.	Flexible steel	Conform to UL 514B. Only steel or malleable iron materials are acceptable.
(1)	Clamp type,	Must be provided with insulated throat.
(2)		Must be OEM approved.
d.	Liquid-tight flexible metal	Shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
(1)		Only steel or malleable iron materials are acceptable.
(2)		Must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
(3)		Must be OEM approved.
e.	Rigid aluminum	Malleable iron, steel or aluminum alloy materials; Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 per-cent copper are prohibited.
(1)	Locknuts and bushings	As specified for rigid steel and IMC conduit.
(2)	Set screw fittings	Not permitted for use with aluminum conduit.
(3)	Indent type connectors or couplings	Are Prohibited.
(4)	Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal"	Are prohibited.
(5)		Must be OEM approved.
e.	Direct burial plastic conduit fittings	
(1)		Fittings shall meet the requirements of UL 514C and NEMA TC3.
(2)		As recommended by the conduit OEM.
f.	Expansion and deflection couplings:	
(1)	Conform	To UL 467 and UL 514B.
(2)	Accommodates	19 mm (0.75 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
g.	Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents	In accordance with UL 467, and the NEC code tables for ground conductors.
h.	Jacket	Must be flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.

3. Conduit Supports

a.	Parts and hardware	Zinc-coat or provide equivalent corrosion
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		protection.
b.	Individual Conduit Hangers	Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
c.	Multiple conduit (trapeze) hangers	Not less than 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 12 gage steel, cold formed, lipped channels; with not less than 9 mm (3/8 inch) diameter steel hanger rods.
d.	Solid Masonry and Concrete Anchors	Self-drilling expansion shields, or machine bolt expansion.

4. Junction, and Pull Boxes

a.	Conforms	To UL-50 and UL-514A.
b.	Cast metal	Where required by the NEC or shown, and equipped with rustproof boxes.
c.	Sheet metal boxes	Galvanized steel, except where otherwise shown.
d.	Flush mounted	Wall or ceiling boxes shall be installed with raised covers so that front face of raised cover is flush with the wall or ceiling. Surface mounted wall or ceiling boxes shall be installed with surface style flat or raised covers.

5. Telecommunications Pathways and Spaces - comply with TIA/EIA-569-A.

a.	Cable trays	Shall be provided and utilized in the system to manage cable in an orderly fashion. Cable management shall be installed in racks and on walls as per OEM's recommendations. Appropriate fire barriers shall be placed around the cables in the sleeves, and unused sleeves shall be properly fire stop-ped.
b.	Cable Duct	Equip with hinged covers, except where removable covers are allowed by specific authorization from the RE in writing.
c.	Cable Duct Fittings	As recommended by the Cable Duct OEM.
d.	Surface Metal Raceway	Shall conform to UL 5 and be "telecommunications service" rated with approved length-way partitions and cable straps to prevent wires and cables from changing from one partitioned pathway to another.
e.	Surface Metal Raceway fittings	As recommended by the Raceway OEM.
f.	Wireway, Metal or Approved Plastic	Shall be "telecommunications service" rated with approved length way partitions

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	and cable straps to prevent wires and cables from changing from one partitioned pathway to another.
g. Wireway, Approved "Basket"	Shall be "telecommunications service" rated with approved length way partitions and cable straps to prevent wires and cables from changing from one partitioned pathway to another.
h. Wireway Fittings	As recommended by the Wireway OEM.

- 6. Interduct
  - a. Outside plant innerduct may be plenum rated where each interduct is 3" (75 mm) and larger.
  - b. Inside Plant Innerduct shall be listed and marked for installation in plenum airspaces and shall be a minimum 1.0" (25mm) inside diameter.
    - 1) Plenum innerducts shall be constructed of low smoke emission, flame retardant PVC.
    - 2) All Innerducts shall be furnished with factory installed nylon pull ropes.
    - 3) Plenum innerducts shall have a UL 94 V-O rating for flame spreading limitation.
    - 4) All innerduct reel lengths shall be provided as necessary to insure that ducts are continuous; one piece runs from ENT to MH; MH to MH; DEMARC to MCR/TER; TR to TR. No innerduct connectors will be allowed between rooms.
    - 5) Pulling accessories used for innerduct shall be compatible with materials being pulled. Accessories shall be furnished as required to complete the installation, including but not limited to, inner duct lubricants, spreaders, applicators, grips, swivels, harnesses, and line missiles (aka blown air).
    - 6) Each segment of innerduct shall extend at least 12.0" (300mm) inches beyond the end of the service conduit tie and/or cable tray. Innerduct ends shall be neatly restrained with wall mount clamps and sealed when cable is installed.

K. WIRE LUBRICATING COMPOUND

- 1. Suitable for the wire insulation and conduit it is used, and shall not harden or become adhesive.
- 2. Shall not be used on wire for isolated type electrical power systems.
- 3. SHALL BE USED ONLY AT THE OEM'S DIRECTON FOR NURSE CALL, PA, FA, SECURITY MANAGEMENT AND OTHER LIKE EMERGENCY SYSTEMS.

L. FIREPROOFING TAPE

- 1. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.
- 2. The tape shall be self-extinguishing and shall not support combustion. It shall be arc-proof and fireproof.
- 3. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus and be resistant to sunlight and ultraviolet light.
- 4. The finished application shall withstand a 200-ampere arc for not less than 30 seconds.
- 5. Securing tape: Glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (3/4 inch) wide.

- M. WARNING TAPE – conform to Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape // detectable // non-detectable // type, red with black letters, and imprinted with "CAUTION BURIED COMMUNICATIONS CABLE BELOW".

**2.05 WIRE MANAGEMENT SYSTEM AND EQUIPMENT**

- A. Wire Management System: The system(s) shall be provided as the management center of the respective cable system: TER, MCR, TR, HE, SCR, ECC, EMCC, etc. It shall perform as a

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platform to house peripheral equipment in a standard relay rack(s), equipment, distribution, interface cabinet(s) and wall mounting boards, panels or rails. It shall be arranged in a manner as to provide convenient access to all installed Facilities Management Service (FMS), OI&T and other equipment.

1. All cables and connections shall be at the rear and/or top of each system interface to conduits, patch panels, punch blocks, wire wrap strips, barrier strip, etc.
  2. Each system shall be custom configured to meet the System design and user needs. The MIN required is a rack, cabinet, or wall mounted TIA/EIA 19" wide and two RUs high.
- B. Wire Management Equipment - the wire management equipment shall be the focal point of each wire management system. It shall provide an orderly interface between outside and inside wires and cables (where used), distribution and interface wires and cables, inter-connection wires and cables and associated equipment, jumper cables, and provide a uniform connection media for all system fire retardant wires and cables and other subsystems.
1. It shall be fully compatible and interface to each cable tray, duct, pathway, wireway, or conduit used in the system.
  2. All interconnection or distribution wires and cables shall enter the system at the top (or from a wireway in the floor) via a over-head protection system and be uniformly routed down either side (or both at the same time) of the frames side protection system then laterally via a anchoring or routing shelf for termination on the rear of each respective terminating assembly.

a.	Vertical Cable Management	Required, 4" X 5" duct style MIN, mounts to side or between 19" equipment racks, mounts in the front or rear of equipment racks or cabinets, contains cover to protect cables, has slots on each side for cable ingress and egress.
(1)	Wall Brackets	Required - 19" wide and 6" deep MIN, accepts and mounts standard TIA/EIA 19" wide patch panels, mounting blocks, etc., hinged on one side to allow rear cable access.
(2)	Floor Frames	Required - in very high density cable locations (ie PBX, TER, TR, MCR rooms), single or double sided metal construction, bold mountable for floor applications, compatible for 300 pair, 66, 110 or 110A blocks, maintains MIN 6" high vertical cable channels, prevents opens, crosses or shorts in cables attached to it
b.	Horizontal Cable Management	
(1)	Combination Organizers	TIA/EIA minimum Category 5E, 19" rack width, in one RU (1.75") multiples to suite system de-sign, front and rear cable rout-ing rings required, six MIN.
(2)	Cable Bars	
(a)	Flat type	Required - 19" rack width rear or front cabinet or rack mount-able, contains

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		cable tie bars and/or wire saddles.
(b)	Duct type	Required - 19" rack width rear (1" X 4" MIN) or front (1 1/2" X 3" MIN) cabinet or rack mount-able; alternate 2" X 4" MIN rear and 3" X 3" front MIN ducts are allowed, each duct in multiple of 1.0 RU (1.75") height.
(3)	Cable Hangers	ALLOWED TO SUPPLEMENT CONDUIT RUNS – DO NOT USE FOR EMERGENCY/ LIFE & PUBLIC SAFETY/ CRITICAL SERVICE COMMUNICATION CABLES – THESE ARE REQUIRED TO BE IN CONDUIT.
(a)	Wall Mountable	WHEN APPROVED - in open cable runs, 3" X 2.5" 2.5" MIN, wall or ceiling mountable, allows cables to be installed and re-moved from hanger, black color metal or high impact plastic construction MIN required.
(b)	Bar Type	WHEN APPROVED - in open cable runs shall be compliment TO AC-CESS Type 66, 110 0R 110A block cable loops; screw mountable required.
(c)	Rack Mountable	Required - above and or inside 19" cabinet panels where wire looms are not provided, allows quick cable attachment or removal, screw mountable.
(4)	Cable Ladder	WHEN APPROVED - shall nominally be 12 in. (305 mm) wide, rung spacing of 9" (225 mm) and be certified / listed for telecommunications service.
(5)	Cable Support	NRTL labeled for support of minimum Category 5E cabling, designed to prevent degradation of cable performance and pin - points that could damage cable.
c.	Vertical or Horizontal Cable Management	
(1)	Cable Ties	Required - 4" MIN length, black in color, ultraviolet resistant.
(2)	Cable Tie Mounting De-vices	
(a)	Adhesive Backed	Required - square style 0.5" X 0.5" MIN, allows two MAX cable ties to be attached in either direction, attaches directly to metal or slick surfaces, re-

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	quires additional screw when mounted to wood or wall back-board.
(b) Screw Type	Required - rectangle style 0.5" X 0.75" MIN, allows one cable tie to be attached in only one direction, requires wood or dry-wall screw for wall or backboard mounting or sheet metal screw for metal mounting.
(c) Screw Anchor Type	Required - rectangle style 0.5 X 0.75" MIN with mounting hole on one end, allows one cable to be attached in only one direction, requires wood or drywall screw for wall or backboard mounting or sheet metal screw for metal mounting.
(3) Cable Clips	WHEN APPROVED - in open CONDUIT runs, nail able or screw mount-able designed with arch to fit CONDUIT diameter without damaging the CONDUIT; plastic white or black color allowed.
(7) Wire Spools	WHEN APPROVED - in open cable runs, round in design with flange on outside to prevent cables from falling off spool, screw mountable via center of spool
(8) Spiral Cable Wrapping	Required - when cable ties are not used to secure all cables, 0.5" OD MIN, weather proof Polyethylene construction MIN required, neatly bonds all loose cables in one bundle without damaging cables, allows cable to ingress and egress from the bundle through the wraps.
(9) Wire Clips and Clamps	Required - when cable ties are not used on short runs, adhesive backed, requires screw mounting to wall or back boards OR metal.
(10) Support Brackets	Provided with cable tie slots for fastening cable ties to Lacing Bars / Brackets.

**2.06 ENVIRONMENTAL REQUIREMENTS:**

- A. Technical submittals shall identify the environmental specifications for housing the system. These environmental specifications shall identify the requirements for initial and expanded system configurations for:
- B. Floor loading for batteries and cabinets.
- C. Minimum floor space and ceiling heights.

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- D. Minimum size of doors for equipment passage.
- E. Power requirements: The bidders shall provide the specific voltage, amperage, phases, and quantities of circuits required.
- F. Air conditioning, heating, and humidity requirements. The Contractor shall identify the ambient temperature and relative humidity operating ranges required preventing equipment damage.
- G. Air conditioning requirements (expressed in BTU per hour, based on adequate dissipation of generated heat to maintain required room and equipment standards).
- H. Proposed floor plan based on the expanded system configuration of the Contractor's proposed PBX (if used) for this Facility.
- I. Conduit size requirement (between equipment room and console room).

**2.07 INSTALLATION KIT:**

- A. The kit(s) shall be provided that, at a MIN, includes all connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks, wiring blocks or wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, etc., required to accomplish a neat and secure installation. All wires shall terminate in a spade lug and barrier strip, wire terminal or wiring block.
- B. Unfinished or unlabeled wire connections shall not be allowed and the system will not be accepted if these types of practices are used.
- C. All unused partially opened installation kit boxes, coaxial cable reels, conduit, cable tray, and/or cable duct bundles, wire rolls, and physical installation hardware shall be turned over to the RE. THIS IS NOT AN ACCEPTABLE ALTERNATE TO THE INDIVIDUAL SPARE EQUIPMENT UNLESS the MIN spare items are provided in these counts meets the levels described herein.
- D. The MIN required installation kits are as follows:

FUNCTIONS	CHARACTERISTICS
1. System Grounding	The grounding kit shall include all cable and installation hardware required. All radio equipment shall be connected to earth ground via internal building wiring, according to the NEC. This includes, but is not limited to:
a. Coaxial Cable Shields and Center Conductor	Only use the Building's Outside Lightning Grounding System.
b. Coaxial / System Cable Lightning Protectors	Only use the Building's Outside Lightning Grounding System.
c. Control Cable Shields	Only use the Building's Inside Signal Grounding System.
d. Data Cable Shields	Only use the Building's Inside Signal Grounding System.
e. Equipment Racks	Only use the Building's Inside Signal Grounding System.
f. Equipment Cabinets	Only use the Building's Inside Signal Grounding System.
g. Conduits	Only use the Building's Inside Signal Grounding System.
h. Cable Duct	Only use the Building's Inside Signal Grounding System.

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	Grounding System.
i. Cable Trays	Only use the Building's Inside Signal Grounding System.
j. Power Panels	Only use the Building's Inside Signal Grounding System
k. Connector Panels	Only use the Building's Inside Signal Grounding System
2. COAXIAL CABLES	The coaxial cable kit shall include all coaxial connectors, cable tying straps, heat shrink tabbing, hangers, clamps, etc., required to accomplish a neat and secure installation.
3. WIRE AND CABLES	The wire and cable kit shall include all connectors and terminals, audio spade lugs, barrier straps, wiring blocks, wire wrap strips, heat shrink tubing, tie wraps, solder, hangers, clamps, labels etc., required to accomplish a neat and orderly installation.
4. CONDUIT, CABLE DUCT AND CABLE TRAY	The kit shall include all conduit, duct, trays, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat and secure conduit, cable duct, and/or cable tray installation in accordance with the NEC and this document.
5. EQUIPMENT INTERFACE	The equipment kit shall include any item or quantity of equipment, cable, mounting hardware and materials needed to interface systems and sub-systems according to the OEM requirements and this document.
6. LABELS / LABELING	The labeling kit shall include any item or quantity of labels, tools, stencils, and materials needed to completely and correctly label each sub-system according to the OEM requirements, record drawings, and this document – see Labeling Kit, Part 2, Section 2.8.
7. WIRE MANAGEMENT	The wire management kit shall include any item (i.e. cable wrap, guides, hangers, holders, forms, etc.) in sufficient quantity to provide a neat and orderly wire and cable installation between and inside all system components.

8. DOCUMENTATION	The documentation requirement of the Installation Kit shall include any item or quantity of items, computer discs, record drawings, equipment, maintenance, and operation manuals, and OEM materials needed to completely and correctly provide the system documentation as required by this specification document and explained herein.
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**2.08 LABELING**

- A. Labels: Provide labeling for equipment, new cabling and termination hardware located within the Facility in accordance with TIA/EIA-606. Handwritten labeling is unacceptable. Stenciled lettering for cable and termination hardware shall be provided using (thermal ink trans-fer process) (laser printer)
  - 1. Cable Tag Installation: Install cable tags for each TIP cable or wire located in manholes, handholes, and vaults including each splice. Tag new wire and cable provided under this contract and existing wire and cable which are indicated to have splices and terminations provided by this contract. The labeling of TIP cable tag identifiers shall be in accordance with TIA/EIA-606. Do not provide handwritten letters. Install cable tags so that they are clearly visible without disturbing any cabling or wiring in the manholes, handholes, and vaults.
  - 2. Equipment Labels: System equipment shall be permanently labeled with contrasting plastic laminate or Bakelite material. System equipment shall be labeled on the face of the unit corresponding to its source. Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two (2) sheet-metal screws or two (2) rivets (Alternates to the nameplates will be considered during the technical submittal approval process).
  - 3. Clearly, consistently, logically and permanently mark switches, connectors, jacks, relays, receptacles and electronic and other equipment.
  - 4. Engrave and paint fill all receptacle panels using 1/8" (minimum) high lettering and contrasting paint.
  - 5. For rack-mounted equipment, use engraved Lamacoid labels with white 1/8" (minimum) high lettering on black background. Label the front and back of all rack-mounted equipment.
  - 6. Where multiple pieces of equipment reside in the same rack group, clearly and logically label each indicating to which room, channel, receptacle location, etc. they correspond.
  - 7. Permanently label cables at each end, including intra-rack connections. Labels shall be covered by the same, transparent heat-shrink tubing covering the end of the overall jacket. Alternatively, computer generated labels of the type which include a clear protective wrap may be used.
  - 8. Contractor's name shall appear no more than once on each continuous set of racks. The Contractor's name shall not appear on wall plates or portable equipment.
- B. Ensure each OEM supplied item of equipment has appropriate NRTL (aka UL) Labels / Marks for the service the equipment is performed permanently attached / marked. EQUIPMENT INSTALLED NOT BEARING THESE MARKS WILL NOT BE ALLOWED TO BE A PART OF THE SYSTEM. THE CONTRACTOR SHALL BEAR ALL COSTS REQUIRED TO PROVIDE REPLACEMENT EQUIPMENT WITH APPROVED UL MARKS.

**2.09 COMMUNICATIONS SYSTEM GROUND:**

- A. In addition to the requirements outlined in SECTION 27 05 26 – GROUNDING AND BONDING FOR COMMUNICAITONS SYSTEMS, the contractor shall provide a circulating system "Signal



Ground” that is separate from other Facility grounding systems (i.e. electrical, lightning, building, etc.) as described herein.

- B. Proper communications system grounding and bonding shall be provided for each: SPDP of Presence, ENTR (DEMARC), TER, TOR, MCR, MCOR, PCR, SCC, ECR, EMCR, STR(s), HER, TRs, TCOs; and insure all internal telecommunications equipment installed in these areas are connected to it as described herein.
- C. Reference shall be made to proper codes and standards, such that all grounding systems must comply with all applicable National, Regional, and Local Building and Electrical codes. The most stringent code of these governing bodies shall apply.
- D. Technical Characteristics

1.	Connectors	Enclosed Circular Coated, Sealed and Plated Copper MIN #0 AWG Lug, or as specified by the RE
2.	Wire	Stranded Copper # 0 AWG (minimum) with protective jacket, or as specified by the RE

**2.10 LIGHTNING PROTECTION SYSTEM/GROUND:**

- A. In addition to SECTION 26 41 00 – FACILITY LIGHTNING PROTECTION requirements, the contractor shall provide a lightning protection connection system for the communications systems / circuits totally and externally to the building. The use of internal electrical or signal grounding systems is not acceptable and will not be approved. The Contractor shall provide this system if it is not previously provided as a part of the contract.
- B. System Building Inputs, Aerial Cables and Underground Cables: These locations and equipment items shall be grounded with cooper wire run external to the building and connected to the earth ground. If the location and/or equipment item is to be installed in an area not protected by lightning rods or if the location and / or equipment item is to be elevated above existing lightning rod protection, the Contractor shall immediately notify the RE in writing regarding the lightning strike hazard.
- C. Technical Characteristics

1.	Connections	To the Facility’s Lightning Protection System as required by the RE (if no Facility system is present – the contractor shall provide a separate Minimum #0 AWG stranded copper wire grounding cable secured and connected outside of the building to the earth as specified by the RE)
2.	Connectors	Enclosed Circular Coated, Sealed and Plated Copper Minimum #0 AWG Lug, or as specified by the RE
3.	Signal Wire/ Cable Grounding Protectors	Provided according to the OEM’s recommendations for the specific cable, circuit or system’s wires and cables. Each protector shall be connected to the lightning protection system as aforementioned.

- D. System Building Inputs, Aerial Cables and Underground Cables: These locations and equipment items shall be grounded with cooper wire run external to the building and connected

to the earth ground. If the location and/or equipment item is to be installed in an area not protected by lightning rods or if the location and / or equipment item is to be elevated above existing lightning rod protection, the Contractor shall immediately notify the RE in writing regarding the lightning strike hazard.

E. Technical Characteristics

Connections	To the Facility's Lightning Protection System as required by the RE (if no Facility system is present – the contractor shall provide a separate Minimum #0 AWG stranded copper wire grounding cable secured and connected outside of the building to the earth as specified by the RE)
Connectors	Enclosed Circular Coated, Sealed and Plated Copper Minimum #0 AWG Lug, or as specified by the RE
Grounding Protectors	Provided according to the OEM's recommendations for the specific cable, circuit or system's wires and cables. Each protector shall be connected to the lightning protection system as aforementioned.

**PART 3 – EXECUTION**

**3.01 INSTALLATION:**

- A. The Contractor shall use the criteria and requirements of this PART to complete the detailed installation of the System. The Design shall include computer RF modeling and site surveys as described herein. The Contractor shall be able to show design RF signal level(s) to sub-room precision for all room(s) /area(s) within the approved defined coverage area(s). The RE shall provide the Contractor with compatible drawings from the project Architect. If the drawings are within BIM then it is the responsibility of the Contractor to modify the BIM Model for use in their wireless modeling which shall include, at a minimum, the creation of 2-D Floor Plans, Reflected Ceiling Plans (RCP) and elevations.
- B. GENERAL SYSTEM INSTALLATION
  - 1. After the contract's been awarded, and within the time period specified in the contract, the Contractor shall deliver the total system in a manner that fully complies with the requirements of this specification. The Contractor shall make no substitutions or changes in the System without written approval from the RE and PM.
  - 2. The Contractor shall install all equipment and systems in a manner that complies with accepted industry standards of good practice, OEM instructions, the requirements of this specification, and in a manner which does not constitute a safety hazard. The Contractor shall insure that all installation personnel understands and complies with all the requirements of this specification.
  - 3. The Contractor shall provide written verification to the RE at time of installation, that the type of wire/cable being provided is recommended and approved by the OEM. The Contractor is responsible for providing the proper size and type of cable duct and/or conduit and wiring even though the actual installation may be by another subcontractor.
  - 4. Active electronic component equipment shall consist of solid state components, be rated for continuous duty service, comply with the requirements of FCC and NRTL standards for DAS equipment, systems, and service.

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5. All passive distribution equipment shall meet or exceed -80 dB radiation shielding specifications.
6. All passive equipment shall be connected according to the OEM's specifications to insure future correct termination, isolation, impedance match, and signal level balance at each telephone/data outlet.
7. The Contractor shall install suitable filters, traps, directional couplers, splitters, TR's, and pads for minimizing interference and for balancing the System. Items used for balancing and minimizing interference shall be able to pass DAS control, Lightwave (fiber optic) // , RF// , Video// , HDTV// , Security// , Emergency// , Safety// and \_\_\_\_\_ // signals in the frequency bands selected, in the direction specified, with low loss, and high isolation, and with minimal delay of specified frequencies and signals. The Contractor shall provide all equipment necessary to meet the requirements outlined herein and the System performance standards.
8. Noise filters and surge protectors shall be provided for each equipment interface cabinet, switch equipment cabinet, control console, local, and remote active equipment locations to ensure protection from input primary AC power surges and noise glitches are not induced into low Voltage data circuits.
9. Where TCOs are installed adjacent to each other, install one outlet for each instrument.
10. All lines shall be terminated in a suitable manner to facilitate future expansion of the System as described (re 50% and expansion information) described in PART 2, PARAGRAPHS 2.4.A; 2.4.B.5; 2.4.B.8.c; 2.4.F.3.d.20; 2.4.F.3.e.3); 2.4.J.6 & 2.4.J.7 .  
There shall be a minimum of one (1) spare:
  - a. 25 pair UTP cable (current installed AWG),
  - b. 25 pair STP control cable (current installed AWG),
  - c. Six (6) pair single mode fiberoptic cable,
    - 1) 8/125-um; 0.10 Aperture; 1,300-nM; per TIA 492CAAA,
    - 2) 8/125-um; 0.10 Aperture; 1,550-nM; per TIA 492E000,
  - d. 12 pair mulimode fiberoptic cable,
    - 1) 62.5/125-um; per TIA 4922AAA, 472D000, and ICEA S-87-640,
    - 2) 50/125-um; Optically Enhanced American (not European) Standard; per TIA 492AAAB.
  - e. Each cable shall be provided at each distribution point shown on the TIP drawings.
11. Terminating resistors or devices shall be used to terminate all unused branches, outlets, equipment ports of the System, and shall be devices designed for the purpose of terminating fiber optic or twisted pair // , and coaxial // // , and lightwave // cables carrying telephone and data // , and analog // signals in telephone and data // , and analog video // // , and lightwave // systems.
12. Equipment installed outdoors shall be weatherproof or installed in weatherproof enclosures with hinged doors and locks with two matching keys (NOTE ALL CABINET LOCKS SHALL BE VENDING MACHINE TYPE LOCKS LIKE KEYED WITH INDOOR CABINETS).
13. Equipment installed indoors shall be installed in metal cabinets with hinged doors and locks with two matching keys (NOTE ALL CABINET LOCKS SHALL BE VENDING MACHINE TYPE LOCKS LIKE KEYED WITH OUTDOOR CABINETS).
14. All interconnecting twisted pair, fiberoptic // or coaxial // cables shall be terminated on equipment terminal boards, punch blocks, breakout boxes, splice blocks, and unused equipment ports/taps shall be terminated according to the OEM's instructions for telephone cable systems without adapters. The Contractor shall not leave unused or spare twisted pair wire, fiberoptic // , or coaxial // cable unterminated, unconnected, loose or unsecured
15. Color code all distribution wiring to conform to the Telephone Industry standard, EIA/TIA, and this document, whichever is the more stringent. At a minimum, all equipment, cable duct and/or conduit, enclosures, wiring, terminals, and cables shall be clearly and permanently labeled according to and using the provided record drawings, to facilitate

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installation and maintenance.

16. Connect the System's primary input AC power to the Facility' Critical Branch of the Emergency AC power distribution system as shown on the plans or if not shown on the plans consult with RE regarding a suitable circuit location prior to bidding.
17. Plug-in connectors shall be provided to connect all equipment, except coaxial cables and interface points. Coaxial cable distribution points and RF transmission lines shall use coaxial cable connections recommended by the cable OEM and approved by the System OEM. Base-band cable systems shall utilize barrier terminal screw type connectors, at a minimum. Crimp type connectors installed with a ratchet type installation tool are and acceptable alternate as long as the cable dress, pairs, shielding, grounding, and connections and labeling are provided the same as the barrier terminal strip connectors. Tape of any type, wire nuts, or solder type connections are unacceptable and will not be approved.
18. All equipment faceplates utilized in the System shall be stainless steel, anodized aluminum, or UL approved cyclac plastic for the areas where provided.

C. CONDUIT AND SIGNAL DUCTS

1. Conduit
  - a. The Contractor shall employ the latest installation practices and materials. The Contractor shall provide conduit, junction boxes, connectors, sleeves, weather heads, pitch pockets, and associated sealing materials not specifically identified in this document as GFE. Conduit penetrations of walls, ceilings, floors, interstitial space, fire barriers, etc., shall be sleeved and sealed. The minimum conduit size shall be as described herein.
  - b. All telecommunications emergency, critical, life support and safety cables shall be installed in separate conduit and/or signal ducts (exception from the separate conduit requirement to allow telecommunications cables to be installed in telecommunications approved partitioned cable tray may be granted in writing by the RE if requested). The determination as to which SECTION 27 & 28 SYSTEM ARE RATED FOR EMERGENCY SERVICE CAN BE FOUND IN PART 1 OF THIS DOCUMENT. Conduits shall be provided as described herein and in accordance with Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and NEC Articles 517 for Critical Care and 800 for Communications systems, at a minimum.
  - c. When metal, plastic covered, etc., flexible cable protective armor or systems are specifically authorized to be provided for use in the System, their installation guidelines and standards shall be as specified herein, Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and the NEC.
  - d. When "innerduct" flexible cable protective systems is specifically authorized to be provided for use in the System, it's installation guidelines and standards shall be as the specified herein, Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and the NEC.
  - e. Conduit (including GFE) fill shall not exceed 40%. Each conduit end shall be equipped with a protective insulator or sleeve to cover the conduit end, connection nut or clamp, to protect the wire or cable during installation and remaining in the conduit. Electrical power conduit shall be installed in accordance with the NEC. AC power conduit shall be run separate from communications conduit.
  - f. Ensure that Critical Care Nurse Call, PA, DAS, Radio Paging, Police Two-Way Radio, Police Security Management, Emergency and Safety Systems (as identified by NEC Section 517 & 800; and UL) are completely separated and mechanically protected from all other systems by conduit and approved telecommunications partitioned cable tray or baskets.
2. Signal Duct, Cable Duct, or Cable Tray
  - a. The Contractor shall use existing conduit, signal duct, cable duct, and/or cable tray, when identified and approved by the RE.

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- b. Approved signal and/or cable duct shall be a minimum size of 100 mm x 100 mm (4 in. X 4 in.) inside diameter with removable tops or sides, as appropriate. Protective sleeves, guides or barriers are required on all sharp corners, openings, anchors, bolts or screw ends, junction, interface and connection points.
  - c. Approved cable tray shall be fully covered, mechanically and physically telecommunications approved partitioned for multiple electronic circuits use, and be NRTL listed and labeled for use with telecommunication circuits and/or systems. The RE shall approve width and height dimensions.
- D. CONNECTORS: Circuits, transmission lines, and signal extensions shall have continuity, correct connection and polarity. A uniform polarity shall be maintained between all points in the system.
- 1. Wires:
    - a. Wire ends shall be neatly formed and where insulation has been cut, heat shrink tubing shall be employed to secure the insulation on each wire. Tape of any type is not acceptable.
    - b. Audio spade lugs shall be installed on each wire (including spare or unused) end and connect to screw terminals of appropriate size barrier strips.
    - c. AC barrier strips shall be provided with a protective cover to prevent accidental contact with wires carrying live AC current.
    - d. Punch blocks are approved for signal, not AC wires.
    - e. Wire Nut or "Scotch Lock" connectors are not acceptable for signal wire installation.
  - 2. Cables: Each connector shall be designed for the specific size cable being used and installed with the OEM's approved installation tool. Typical system cable connectors include; but, are not limited to: Audio spade lug, punch block, wire wrap, etc.
  - 3. Line or Microphone Audio: Each connector shall be installed according to the cable or connector OEM's instructions and use the OEM's approved installation tool. Install the connector's to provide and maintain the following audio signal polarity:
    - a. XLR type connectors Signal or positive conductor is pin 3; common or neutral conductor is pin 2; ground conductor is pin 1.
    - b. Two and 3 conductor 1/4" Signal or positive conductor is tip; neutral or 1/8" Phono plugs conductor is ring and ground or shield and jacks conductor is sleeve.
    - c. RCA Phono Plugs the Signal or positive conductor is tip; and Jacks neutral or shield conductor is sleeve.
  - 4. Speaker Line Audio:
    - a. Each connector shall be installed according to the cable, transformer or speaker OEM instructions and using the OEM's approved installation tool. The Contractor shall ensure each speaker is properly phased and connected in the same manner throughout the System using two conductor type wires.
    - b. One of the conductors shall be color coded to aid in establishing speaker signal polarity. Each speaker line shall be permanently soldered or audio spade lug connected to each appropriate speaker or line matching transformer connection terminal. Speaker line connection to each audio amplifier shall use audio spade lugs, as described herein.
- E. AC POWER: AC power wiring shall be run separately from communications cable.
- F. GROUNDING (SEE PARAGRAPH 2.9 HEREIN FOR THIS REQUIREMENT)
- G. EQUIPMENT ASSEMBLY
- 1. Cabinets: Each cabinet/enclosure shall be: floor or wall mounted with standard knockout holes for conduit connections or cable entrance; provide for ventilation of the equipment; have front and rear locking doors (except wall mounted cabinets that require only a front locking door); power outlet strip(s), and connector or patch panel(s).
    - a. Rack (including freestanding radio relay) mounted equipment shall be installed in the enclosure's equipment adjustable mounting rails with equipment normally requiring

adjustment or observation mounted so operational adjustment(s) can be conveniently made.

- 1) Heavy equipment shall be mounted with rack slides or rails allowing servicing from the front of the enclosure. Heavy equipment shall not depend only upon front panel mounting screws for support.
  - 2) Equipment shall be provided with sufficient cable slack to permit servicing by removal of the installed equipment from the front of the enclosure.
  - 3) A color matched blank panel (spacer) of 44 mm (1.75 in.) high, shall be installed between each piece of equipment (active or passive) to insure adequate air circulation.
  - 4) The enclosure shall be designed for efficient equipment cooling and air ventilation. Each console or cabinet shall be equipped with a quiet fan and non-disposable air filter.
- b. Enclosures and racks shall be installed plumb and square. Each shall be permanently attached to the building structure and held firmly in place. Fifteen inches of front vertical space opening shall be provided for additional equipment.
  - c. Signal connector, patch, and bulkhead panels (i.e.: audio, data, control, analog video, etc.) shall be connected so that outputs from each source, device or system component shall enter the panel at the top row of jacks, beginning left to right as viewed from the front, which will be called "inputs". Each connection to a load, device or system component shall exit the panel at the bottom row of jacks, beginning left to right as viewed from the front, which will be called "outputs".
  - d. Equipment located indoors shall be installed in metal racks or enclosures with hinged doors to allow access for maintenance without causing interference to other nearby equipment.
  - e. Cables shall enter the equipment racks or enclosures in such a manner that allows all doors or access panels to open and close without disturbing or damaging the cables.
  - f. All distribution hardware shall be securely mounted in a manner that allows access to the connections for testing and provides sufficient room for the doors or access panels to open and close without disturbing the cables.
2. UPS: It is acceptable to power all TER, MCR, TR & STRs FMS Equipment from single battery backup system, in lieu of individual cabinet mounted UPS, as long as the system performance standards are met.
    - a. If this option is used it is acceptable to provide one AC input surge protector to isolate the battery backup system from the Facility's Emergency AC Generator Circuit as long as it is properly sized and the system performance standards are met; AND has electrical supervision provided as described herein.

H. LABELING/LABELS (SEE PARAGRAPH 2.8 HEREIN FOR THIS REQUIREMENT)

I. LIGHTNING PROTECTION SYSTEM (SEE PARAGRAPH 2.10 HEREIN FOR THIS REQUIREMENT)

### 3.02 TESTS

- A. INTERIM INSPECTION: At approximately 40-50% of installation at the direction of the CFM PE, PM, SRE or RE (Additional inspection(s) may be required at the direction of the CFM PE, PM, SRE or RE):
  1. This inspection shall verify the equipment and system being provided adheres to the installation and technical requirements of this document.
    - a. The interim inspection will be conducted by an OEM and factory-certified contractor representative; AND witnessed by a CFM RE Staff Member(s), Facility AND SMCS 0050P2H3 Representatives.
    - b. Each item of installed equipment shall be checked to insure appropriate NRTL (UL) listing labels and markings are in place.

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- c. This inspection shall verify cabling terminations in all telecommunications and head end rooms and at workstation locations adhere to color code for T568B // T568A // pin assignments and cabling connections are in compliance with ANSI/EIA/TIA standards.
      - d. Visually confirm Category 5e // ----- // cable marking at TCOs, CCSs locations and patch cords.
    2. The entire communications circulating ground system and each TGB, the separate earth ground point and lightning protection system shall be reviewed.
    3. Cable tray, conduit and path/wire-way installation practice shall be reviewed.
    4. Perform fiber optical cable field inspection tests via attenuation measurements on factory reels and provide results along with manufacturer certification for factory reel tests. Remove failed cable reels from project site upon attenuation test failure.
    5. The Contractor shall notify the RE, in writing, of the estimated date the Contractor expects to be ready for the interim inspection, at least 20 working days before the requested inspection start date.
    6. Results of the interim inspection shall be provided to the CFM PE, PM, SRE and RE.
      - a. If major or multiple deficiencies are discovered, a second interim inspection may be required before permitting the Contractor to continue with the system installation until the present deficiency(s) are corrected.
      - b. The SRE or RE shall determine if an additional inspection(s) is/are required: OR if the Contractor will be allowed to proceed with the installation.
      - c. In either case, re-inspection of the deficiency(s) noted during the interim inspection(s), will be part of the proof of performance test final acceptance test.
      - d. The interim inspection shall not affect the Systems' completion date unless directed by the CFM PE, PM, SRE and RE.
      - e. The Facility Contracting Officer shall ensure all test documents become a part of the Systems' documentation.
- B. PRETESTING: Upon completing the installation of the System, the Contractor shall align and balance the system. The Contractor shall pretest the entire system.
  1. Pretesting Procedure:
    - a. During the system pretest, the Contractor shall verify (utilizing the approved spectrum analyzer and test equipment) that the System is fully operational and meets all the system performance requirements of this standard.
    - b. The Contractor shall pretest and verify that all System functions and specification requirements are met and operational, no unwanted aural effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise, etc. are present. The Contractor shall measure and record the aural carrier levels of each system DAS and data channel, at each of the following points in the system:
      - 1) Utility Provider Entrance.
      - 2) Buried Conduit Duct(s) locations (if required).
      - 3) Manhole(s) & Grab Boxes (if required).
      - 4) ENR (aka DEMARC).
      - 5) PBX (if used) Interconnections.
      - 6) MCR Interconnections.
      - 7) MCOR Interconnections.
      - 8) TER Interconnections.
      - 9) TOR Interconnections.
      - 10) PCR Interconnections.
      - 11) ECR Interconnections.
      - 12) SCR Interconnections.
      - 13) System interface(s) in locations listed herein.
      - 14) System Grounding.
      - 15) Waterproofing.

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- 16) UPS Areas.
  - 17) Other(s) as required by AHJ (SMCS 005OP2H3).
2. The Contractor shall provide four (4) copies of the recorded system pretest measurements and the written certification that the System is ready for the formal acceptance test shall be submitted to the RE.
- C. ACCEPTANCE TEST: After the System has been pretested and the Contractor has submitted the pretest results and certification to the RE, then the Contractor shall schedule an acceptance test date and give the RE 30 days written notice prior to the date the acceptance test is expected to begin.
1. The System shall be tested in the presence of a Government Representative, SMCS 005OP2H3 and an OEM certified representative. The System shall be tested utilizing the approved test equipment to certify proof of performance and Life Safety compliance.
  2. The System shall be tested to certify proof of performance and FCC compliance. The test shall verify that the total System meets all the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.
  3. The acceptance test shall be performed on a "go-no-go" basis. Only those contractor minor adjustments required to show proof of performance shall be allowed.
    - a. The test shall demonstrate and verify that the installed System does comply with all requirements of this specification under operating conditions.
    - b. The System shall be rated as either acceptable or unacceptable at the conclusion of the test.
    - c. Failure of any part of the System that precludes completion of system testing, and which cannot be repaired in four (4) hours, shall be cause for terminating the acceptance test of the System. Repeated failures that result in a cumulative time of eight (8) hours to affect repairs shall cause the entire System to be declared unacceptable.
  4. If it is determined the system will require retesting, System Retest shall be rescheduled at the convenience of the Government and all costs borne by the Contractor at the direction of the SRE.
- D. Acceptance Test Procedure
1. Physical and Mechanical Inspection
    - a. The Government Representative(s) and SMCS 005OP2H3 will tour all major areas where the System is and all sub-systems are completely and properly installed to insure they are operationally ready for proof of performance testing. A system inventory including available spare parts will be taken at this time. Each item of installed equipment shall be checked to ensure appropriate UL certification labels are affixed.
    - b. The System diagrams, record drawings, equipment manuals, Telecommunications Infrastructure Plant (TIP) Auto CAD Disks, intermediate, and pretest results shall be formally inventoried and reviewed.
    - c. Failure of the System to meet the installation requirements of this specification shall be grounds for terminating all testing.
  2. Operational Test
    - a. After the Physical and Mechanical Inspection of each DAS location listed in 3.2.D.1, terminating, mounting and interface equipment shall be checked to verify that it meets all FCC requirements outlined herein. A spectrum analyzer shall be utilized to accomplish this requirement.
    - b. The DAS Cable distribution system shall be checked at each interface, junction, and distribution point to insure all meets the standards outlined herein.
    - c. Each DAS location shall be functionally tested at the same time utilizing the Spectrum Analyzer.
    - d. Once these tests have been completed, each installed DAS sub-system function shall be tested as a unified, functioning and fully operating system.



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3. Individual Item Test: The VACO SMCS 005OP2H3 Government Representative will select individual items of DAS equipment for detailed proof of performance testing until 100% of the System has been tested and found to meet the contents of this specification. Each DAS item shall meet or exceed the minimum requirements of this document
- E. Test Conclusion: (see Part 1.13.A.3 for VA "Conditions of Acceptance"): At the conclusion of the Acceptance Test, using the generated punch list (or discrepancy list) the VA and the Contractor shall jointly agree to the results of the test, and reschedule testing on deficiencies and shortages with the RE. Any retesting to comply with these specifications will be done at the Contractor's expense.
  1. Please refer to PART 1, PARAGRAPH 1.13 VA ACCEPANCE OF SYSTEM MOU, CONTRACTORS WARRANTY / GUARANTEE: SUB-PARAGRAPH 1.13.A.3 for VA Conditions of System Acceptance.
  2. If the System is declared unacceptable without conditions, all rescheduled testing expenses will be borne by the Contractor.
- F. CONNECTING TO THE IWS / DAS SYSTEM
  1. The Contractor shall manage and collect all FCC License / Listings and provide them to the RE and VAMC Chief of FMS when VA's accepts the System.
  2. MANAGE EACH WSP'S CONNECTION TO THE SYSTEM: The Contractor shall represent the VAMC during negotiations with each WSP, insure all VA / GSA Land Management and Conditional Use Permits / Agreements are completed and approved by VA (VA Chief of FMS will provide appropriate forms), coordinate site preparation, assist with each WSPs' installation, and coordinate connection of each WSP to the System. Each WSP's integration to the System, shall be turn-key and shall include BDS(s), donor antenna(s), installation materials/equipment, wire management and updated system drawings.
  3. MANAGE EACH VAMNC CONNECTION(S) TO THE SYSTEM: The Contractor shall coordinate site preparation, assist with each pre approved FMS installation, and coordinate connection of each FMS radio / wireless system to the System. Each FMS integration to the System, shall be turn-key and shall include BDS(s), donor antenna(s), installation materials/equipment, wire management and updated system drawings.
  4. MANAGE ADDITIONAL SERVICE CONNECTION(S) TO THE SYSTEM: The Contractor shall represent the VAMC during negotiations with each Service, insure all VA / GSA Land Management and Conditional Use Permits / Agreements are completed and approved by VA (VA Chief of FMS will provide appropriate forms), coordinate site preparation, assist with the Service installation, and coordinate connection of each Service to the System. Each Service integration to the system, shall be turn-key and shall include BDS(s), donor antenna(s), installation materials/equipment, wire management and updated system drawings.

**3.03 TRAINING: IN ADDITION TO THE TRAINING PROVIDED IN ACCORDANCE WITH ARTICLE, INSTRUCTIONS, OF SECTION 01 00 00, GENERAL REQUIREMENTS):**

- A. Furnish the services of a factory-trained engineer or technician for a total of two (2) each four (4) hour classes to instruct designated Facility personnel. Instruction shall include cross connection, corrective, and preventive maintenance of the System and equipment.
- B. Before the System can be accepted by the VA, this training must be accomplished. Training will be scheduled at the convenience of the Facilities Contracting Officer and Chief of Engineering Service.
- C. Training shall be provided for the particular equipment(s) or system(s) as required in each associated specification and described as follows:
  1. A training schedule shall be developed and submitted by the contractor and approved by the RE at least 30 days prior to the planned training.
  2. Provide thorough training of all staff assigned to those units receiving new DAS (other) communications equipment(s) and system(s). A separate training room will be set up that

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allows this type of individualized training utilizing in-service training unit, prior to opening of the new Facility //or cut over of the new system//.

3. Provide the following minimum training times and durations:
  - a. Four (4) Weeks prior to the Facility opening for Engineering Staff (in 8-hour increments) – split evenly over 3 weeks and day and night shifts. Coordinate schedule with the RE and Facility Manager (aka Chief of FMS).
  - b. One (1) Week prior to the Facility opening for IT Staff (in 8-hour increments) – both day and night shifts. Coordinate schedule with the RE and IT Staff Supervisor or Manager.
  - c. During the Facility opening four (4) hours for supervisors and system administrators. Coordinate schedule(s) with the Facility's Chief of Staff (CoF) or other CoF designated individual(s).

**END OF SECTION**

**SECTION 280500**  
**COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY**

**PART 1 - GENERAL**

**1.01 DESCRIPTION**

- A. This Section, Common Work Results for Electronic Safety and Security (ESS), applies to all sections of Division 28.
- B. Furnish and install fully functional electronic safety and security cabling system(s), equipment and approved accessories in accordance with the specification section(s), drawing(s), and referenced publications. Capacities and ratings of cable and other items and arrangements for the specified items are shown on each system's required Bill of Materials (BOM) and verified on the approved system drawing(s). If there is a conflict between contract's specification(s) and drawings(s), the contract's specification requirements shall prevail.
- C. The Contractor shall provide a fully functional and operating ESS, programmed, configured, documented, and tested as required herein and the respective Safety and Security System Specification(s). The Contractor shall provide calculations and analysis to support design and engineering decisions as specified in submittals. The Contractor shall provide and pay all labor, materials, and equipment, sales and gross receipts and other taxes. The Contractor shall secure and pay for plan check fees, permits, other fees, and licenses necessary for the execution of work as applicable for the project. Give required notices; the Contractor will comply with codes, ordinances, regulations, and other legal requirements of public authorities, which bear on the performance of work.
- D. The Contractor shall provide an ESS, installed, programmed, configured, documented, and tested. The security system shall include but not limited to: physical access control, intrusion detection, duress alarms, elevator control interface, video assessment and surveillance, video recording and storage, delayed egress, personal protection system, intercommunication system, fire alarm interface, equipment cabinetry, dedicated photo badging system and associated live camera, report printer, photo badge printer, and uninterruptible power supplies (UPS) interface. Operator training shall not be required as part of the Security Contractors scope and shall be provided by the Owner. The Security Contractor shall still be required to provide necessary maintenance and troubleshooting manuals as well as submittals as identified herein. The work shall include the procurement and installation of electrical wire and cables, the installation and testing of all system components. Inspection, testing, demonstration, and acceptance of equipment, software, materials, installation, documentation, and workmanship, shall be as specified herein. The Contractor shall provide all associated installation support, including the provision of primary electrical input power circuits.
- E. Repair Service Replacement Parts On-site service during the warranty period shall be provided as specified under "Emergency Service". The Contractor shall guarantee all parts and labor for a term of one (1) year, unless dictated otherwise in this specification from the acceptance date of the system as described in Part 5 of this Specification. The Contractor shall be responsible for all equipment, software, shipping, transportation charges, and expenses associated with the service of the system for one (1) year. The Contractor shall provide 24-hour telephone support for the software program at no additional charge to the owner. Software support shall include all software updates that occur during the warranty period.
- F. Section Includes:
  - 1. Description of Work for Electronic Security Systems,
  - 2. Electronic security equipment coordination with relating Divisions,
  - 3. Submittal Requirements for Electronic Security,
  - 4. Miscellaneous Supporting equipment and materials for Electronic Security,
  - 5. Electronic security installation requirements.

## 1.02 RELATED WORK

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- B. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping application and use.
- C. Section 08 11 73 - SLIDING METAL FIRE DOORS. Requirements for door installation.
- D. Section 08 35 13.13 - ACCORDIAN FOLDING DOORS. Requirements for door installation.
- E. Section 08 34 59 - VAULT DOORS AND DAY GATES. Requirements for door and gate installation.
- F. Section 08 51 13 - ALUMINUM WINDOWS. Requirements for window installation.
- G. Section 08 71 00 - DOOR HARDWARE. Requirements for door installation.
- H. Section 10 14 00 - SIGNAGE. Requirements for labeling and signs.
- I. Section 26 05 21 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Requirements for power cables.
- J. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.
- K. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.
- L. Section 28 05 28.33 - CONDUITS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.
- M. Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS. Requirements for Commissioning.
- N. Section 28 13 00 - PHYSICAL ACCESS CONTROL SYSTEMS (PACS). For physical access control integration.
- O. Section 28 13 16 - PHYSICAL ACCESS CONTROL SYSTEM AND DATABASE MANAGEMENT. Requirements for control and operation of all security systems.
- P. Section 28 13 53 - SECURITY ACCESS DETECTION. Requirements for screening of personnel and shipments.
- Q. Section 28 16 00 - INTRUSION DETECTION SYSTEM (IDS). Requirements for alarm systems.
- R. Section 28 23 00 - VIDEO SURVEILLANCE. Requirements for security camera systems.
- S. Section 28 26 00 - ELECTRONIC PERSONAL PROTECTION SYSTEM (EPPS). Requirements for emergency and interior communications.
- T. Section 32 31 13 - CHAIN LINK FENCES AND GATES. Requirements for fences.

## 1.03 DEFINITIONS

- A. AGC: Automatic Gain Control.
- B. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- C. BICSI: Building Industry Consulting Service International.
- D. CCD: Charge-coupled device.
- E. Central Station: A PC with software designated as the main controlling PC of the security access system. Where this term is presented with initial capital letters, this definition applies.
- F. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel section.
- G. Controller: An intelligent peripheral control unit that uses a computer for controlling its operation. Where this term is presented with an initial capital letter, this definition applies.
- H. CPU: Central processing unit.

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- I. Credential: Data assigned to an entity and used to identify that entity.
- J. DGP: Data Gathering Panel – component of the Physical Access Control System capable to communicate, store and process information received from readers, reader modules, input modules, output modules, and Security Management System.
- K. DTS: Digital Termination Service: A microwave-based, line-of-sight communications provided directly to the end user.
- L. EMI: Electromagnetic interference.
- M. EMT: Electric Metallic Tubing.
- N. ESS: Electronic Security System.
- O. File Server: A PC in a network that stores the programs and data files shared by users.
- P. GFI: Ground fault interrupter.
- Q. IDC: Insulation displacement connector.
- R. Identifier: A credential card, keypad personal identification number or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.
- S. I/O: Input/Output.
- T. Intrusion Zone: A space or area for which an intrusion must be detected and uniquely identified, the sensor or group of sensors assigned to perform the detection, and any interface equipment between sensors and communication link to central-station control unit.
- U. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- V. LAN: Local area network.
- W. LCD: Liquid-crystal display.
- X. LED: Light-emitting diode.
- Y. Location: A Location on the network having a PC-to-Controller communications link, with additional Controllers at the Location connected to the PC-to-Controller link with RS-485 communications loop. Where this term is presented with an initial capital letter, this definition applies.
- Z. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- AA. M-JPEG: Motion – Joint Photographic Experts Group.
- BB. MPEG: Moving picture experts group.
- CC. NEC: National Electric Code
- DD. NEMA: National Electrical Manufacturers Association
- EE. NFPA: National Fire Protection Association
- FF. NTSC: National Television System Committee.
- GG. NRTL: Nationally Recognized Testing Laboratory.
- HH. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).
- II. PACS: Physical Access Control System; A system comprised of cards, readers, door controllers, servers and software to control the physical ingress and egress of people within a given space

- JJ. PC: Personal computer. This acronym applies to the Central Station, workstations, and file servers.
- KK. PCI Bus: Peripheral component interconnect; a peripheral bus providing a high-speed data path between the CPU and peripheral devices (such as monitor, disk drive, or network).
- LL. PDF: (Portable Document Format.) The file format used by the Acrobat document exchange system software from Adobe.
- MM. RCDD: Registered Communications Distribution Designer.
- NN. RFI: Radio-frequency interference.
- OO. RIGID: Rigid conduit is galvanized steel tubing, with a tubing wall that is thick enough to allow it to be threaded.
- PP. RS-232: An TIA/EIA standard for asynchronous serial data communications between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.
- QQ. RS-485: An TIA/EIA standard for multi-point communications.
- RR. Solid-Bottom or Non-ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.
- SS. SMS: Security Management System – A SMS is software that incorporates multiple security subsystems (e.g., physical access control, intrusion detection, closed circuit television, intercom) into a single platform and graphical user interface.
- TT. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
- UU. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.
- VV. UPS: Uninterruptible Power Supply
- WW. UTP: Unshielded Twisted Pair
- XX. Workstation: A PC with software that is configured for specific limited security system functions.

#### **1.04 QUALITY ASSURANCE**

- A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.
- B. Product Qualification:
  - 1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
  - 2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.
- C. Contractor Qualification:
  - 1. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years experience installing and servicing systems of similar scope and complexity. The Contractor shall be an authorized regional representative of the Security Management System's (PACS) manufacturer. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity which became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system. The references must include a current point of contact, company or agency name, address, telephone number,

complete system description, date of completion, and approximate cost of the project. The owner reserves the option to visit the reference sites, with the site owner's permission and representative, to verify the quality of installation and the references' level of satisfaction with the system. The Contractor shall provide copies of system manufacturer certification for all technicians. The Contractor shall only utilize factory-trained technicians to install, program, and service the PACS. The Contractor shall only utilize factory-trained technicians to install, terminate and service controller/field panels and reader modules. The technicians shall have a minimum of five (5) continuous years of technical experience in electronic security systems. The Contractor shall have a local service facility. The facility shall be located within [60] miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with this contract. The facility shall also include appropriate diagnostic equipment to perform diagnostic procedures. The Resident Engineer reserves the option of surveying the company's facility to verify the service inventory and presence of a local service organization.

2. The Contractor shall provide proof project superintendent with BICSI Certified Commercial Installer Level 1, Level 2, or Technician to provide oversight of the project.
  3. Cable installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International. The staff member shall provide consistent oversight of the project cabling throughout design, layout, installation, termination and testing.
- D. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within eight hours of receipt of notification that service is needed. Submit name and address of service organizations.

#### **1.05 GENERAL ARRANGEMENT OF CONTRACT DOCUMENTS**

- A. The Contract Documents supplement to this specification indicates approximate locations of equipment. The installation and/or locations of the equipment and devices shall be governed by the intent of the design; specification and Contract Documents, with due regard to actual site conditions, recommendations, ambient factors affecting the equipment and operations in the vicinity. The Contract Documents are diagrammatic and do not reveal all offsets, bends, elbows, components, materials, and other specific elements that may be required for proper installation. If any departure from the contract documents is deemed necessary, or in the event of conflicts, the Contractor shall submit details of such departures or conflicts in writing to the owner or owner's representative for his or her comment and/or approval before initiating work.
- B. Anything called for by one of the Contract Documents and not called for by the others shall be of like effect as if required or called by all, except if a provision clearly designed to negate or alter a provision contained in one or more of the other Contract Documents shall have the intended effect. In the event of conflicts among the Contract Documents, the Contract Documents shall take precedence in the following order: the Form of Agreement; the Supplemental General Conditions; the Special Conditions; the Specifications with attachments; and the drawings.

#### **1.06 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. The Government's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site.

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- C. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
1. Mark the submittals, "SUBMITTED UNDER SECTION \_\_\_\_\_".
  2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
  3. Submit each section separately.
- D. The submittals shall include the following:
1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
  2. Submittals are required for all equipment anchors and supports. Submittals shall include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion,) associated with equipment or piping so that the proposed installation can be properly reviewed. //
  3. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.
- E. Submittals shall be in full compliance of the Contract Documents. All submittals shall be provided in accordance with this section. Submittals lacking the breadth or depth these requirements will be considered incomplete and rejected. Submissions are considered multidisciplinary and shall require coordination with applicable divisions to provide a complete and comprehensive submission package. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Government to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted. Additional general provisions are as follows:
1. The Contractor shall schedule submittals in order to maintain the project schedule. For coordination drawings refer to Specification Section 01 33 10 - Design Submittal Procedures, which outline basic submittal requirements and coordination. Section 01 33 10 shall be used in conjunction with this section.
  2. The Contractor shall identify variations from requirements of Contract Documents and state product and system limitations, which may be detrimental to successful performance of the completed work or system.
  3. Each package shall be submitted at one (1) time for each review and include components from applicable disciplines (e.g., electrical work, architectural finishes, door hardware, etc.) which are required to produce an accurate and detailed depiction of the project.
  4. Manufacturer's information used for submittal shall have pages with items for approval tagged, items on pages shall be identified, and capacities and performance parameters for review shall be clearly marked through use of an arrow or highlighting. Provide space for Resident Engineer and Contractor review stamps.
  5. Technical Data Drawings shall be in the latest version of AutoCAD®, drawn accurately, and in accordance with VA CAD Standards CAD Standard Application Guide, and VA BIM Guide. FREEHAND SKETCHES OR COPIED VERSIONS OF THE CONSTRUCTION DOCUMENTS WILL NOT BE ACCEPTED. The Contractor shall not reproduce Contract Documents or copy standard information as the basis of the Technical Data Drawings. If departures from the technical data drawings are subsequently deemed necessary by the Contractor, details of such departures and the reasons thereof shall be submitted in writing to the Resident Engineer for approval before the initiation of work.
  6. Packaging: The Contractor shall organize the submissions according to the following packaging requirements.
    - a. Binders: For each manual, provide heavy duty, commercial quality, durable three (3) ring vinyl covered loose leaf binders, sized to receive 8.5 x 11 in paper, and appropriate capacity to accommodate the contents. Provide a clear plastic sleeve on



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the spine to hold labels describing the contents. Provide pockets in the covers to receive folded sheets.

- 1) Where two (2) or more binders are necessary to accommodate data; correlate data in each binder into related groupings according to the Project Manual table of contents. Cross-referencing other binders where necessary to provide essential information for communication of proper operation and/or maintenance of the component or system.
- 2) Identify each binder on the front and spine with printed binder title, Project title or name, and subject matter covered. Indicate the volume number if applicable.
- b. Dividers: Provide heavy paper dividers with celluloid tabs for each Section. Mark each tab to indicate contents.
- c. Protective Plastic Jackets: Provide protective transparent plastic jackets designed to enclose diagnostic software for computerized electronic equipment.
- d. Text Material: Where written material is required as part of the manual use the manufacturer's standard printed material, or if not available, specially prepared data, neatly typewritten on 8.5 inches by 11 inches 20 pound white bond paper.
- e. Drawings: Where drawings and/or diagrams are required as part of the manual, provide reinforced punched binder tabs on the drawings and bind them with the text.
  - 1) Where oversized drawings are necessary, fold the drawings to the same size as the text pages and use as a foldout.
  - 2) If drawings are too large to be used practically as a foldout, place the drawing, neatly folded, in the front or rear pocket of the binder. Insert a type written page indicating the drawing title, description of contents and drawing location at the appropriate location of the manual.
  - 3) Drawings shall be sized to ensure details and text is of legible size. Text shall be no less than 1/16" tall.
- f. Manual Content: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
  - 1) Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.
  - 2) Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
  - 3) The manuals shall include:
    - (a) Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
    - (b) A control sequence describing start-up, operation, and shutdown.
    - (c) Description of the function of each principal item of equipment.
    - (d) Installation and maintenance instructions.
    - (e) Safety precautions.
    - (f) Diagrams and illustrations.
    - (g) Testing methods.
    - (h) Performance data.
    - (i) Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.

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- (j) Appendix; list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.
- g. Binder Organization: Organize each manual into separate sections for each piece of related equipment. At a minimum, each manual shall contain a title page, table of contents, copies of Product Data supplemented by drawings and written text, and copies of each warranty, bond, certifications, and service Contract issued. Refer to Group I through V Technical Data Package Submittal requirements for required section content.
- h. Title Page: Provide a title page as the first sheet of each manual to include the following information; project name and address, subject matter covered by the manual, name and address of the Project, date of the submittal, name, address, and telephone number of the Contractor, and cross references to related systems in other operating and/or maintenance manuals.
- i. Table of Contents: After the title page, include a type written table of contents for each volume, arranged systematically according to the Project Manual format. Provide a list of each product included, identified by product name or other appropriate identifying symbols and indexed to the content of the volume. Where more than one (1) volume is required to hold data for a particular system, provide a comprehensive table of contents for all volumes in each volume of the set.
- j. General Information Section: Provide a general information section immediately following the table of contents, listing each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the installer and maintenance Contractor. In addition, list a local source for replacement parts and equipment.
- k. Drawings: Provide specially prepared drawings where necessary to supplement the manufacturers printed data to illustrate the relationship between components of equipment or systems, or provide control or flow diagrams. Coordinate these drawings with information contained in Project Record Drawings to assure correct illustration of the completed installation.
- l. Manufacturer's Data: Where manufacturer's standard printed data is included in the manuals, include only those sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation. Where more than one (1) item in tabular format is included, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation and delete references to information which is not applicable.
- m. Where manufacturer's standard printed data is not available and the information is necessary for proper operation and maintenance of equipment or systems, or it is necessary to provide additional information to supplement the data included in the manual, prepare written text to provide the necessary information. Organize the text in a consistent format under a separate heading for different procedures. Where necessary, provide a logical sequence of instruction for each operating or maintenance procedure. Where similar or more than one product is listed on the submittal the Contractor shall differentiate by highlighting the specific product to be utilized.
- n. Calculations: Provide a section for circuit and panel calculations.
- o. Loading Sheets: Provide a section for DGP Loading Sheets.
- p. Certifications: Provide section for Contractor's manufacturer certifications.
- 7. Contractor Review: Review submittals prior to transmittal. Determine and verify field measurements and field construction criteria. Verify manufacturer's catalog numbers and conformance of submittal with requirements of contract documents. Return non-conforming or incomplete submittals with requirements of the work and contract documents. Apply Contractor's stamp with signature certifying the review and verification of products occurred, and the field dimensions, adjacent construction, and coordination of information is in accordance with the requirements of the contract documents.

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8. Resubmission: Revise and resubmit submittals as required within 15 calendar days of return of submittal. Make resubmissions under procedures specified for initial submittals. Identify all changes made since previous submittal.
  9. Product Data: Within 15 calendar days after execution of the contract, the Contractor shall submit for approval a complete list of all of major products proposed for use. The data shall include name of manufacturer, trade name, model number, the associated contract document section number, paragraph number, and the referenced standards for each listed product.
- F. Group 1 Technical Data Package: Group I Technical Data Package shall be one submittal consisting of the following content and organization. Refer to VA Special Conditions Document for drawing format and content requirements. The data package shall include the following:
1. Section I - Drawings:
    - a. General – Drawings shall conform to VA CAD Standards Guide. All text associated with security details shall be 1/8" tall and meet VA text standard for AutoCAD™ drawings.
    - b. Cover Sheet – Cover sheet shall consist of Project Title and Address, Project Number, Area and Vicinity Maps.
    - c. General Information Sheets – General Information Sheets shall consist of General Notes, Abbreviations, Symbols, Wire and Cable Schedule, Project Phasing, and Sheet Index.
    - d. Floor Plans – Floor plans shall be produced from the Architectural backgrounds issued in the Construction Documents. The contractor shall receive floor plans from the prime A/E to develop these drawing sets. Security devices shall be placed on drawings in scale. All text associated with security details shall be 1/8" tall and meet VA text standard for AutoCAD™ drawings. Floor plans shall identify the following:
      - 1) Security devices by symbol,
      - 2) The associated device point number (derived from the loading sheets),
      - 3) Wire & cable types and counts
      - 4) Conduit sizing and routing
      - 5) Conduit riser systems
      - 6) Device and area detail call outs
    - e. Architectural details – Architectural details shall be produced for each device mounting type (door details for EECS and IDS, Intrusion Detection system (motion sensor, vibration, microwave Motion Sensor and Camera mounting,
    - f. Riser Diagrams – Contractor shall provide a riser diagram indicating riser architecture and distribution of the SMS throughout the facility (or area in scope).
    - g. Block Diagrams – Contractor shall provide a block diagram for the entire system architecture and interconnections with SMS subsystems. Block diagram shall identify SMS subsystem (e.g., electronic entry control, intrusion detection, closed circuit television, intercom, and other associated subsystems) integration; and data transmission and media conversion methodologies.
    - h. Interconnection Diagrams – Contractor shall provide interconnection diagram for each sensor, and device component. Interconnection diagram shall identify termination locations, standard wire detail to include termination schedule. Diagram shall also identify interfaces to other systems such as elevator control, fire alarm systems, and security management systems.
    - i. Security Details:
      - 1) Panel Assembly Detail – For each panel assembly, a panel assembly details shall be provided identifying individual panel component size and content.
      - 2) Panel Details – Provide security panel details identify general arrangement of the security system components, backboard size, wire through size and location, and power circuit requirements.

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- 3) Device Mounting Details – Provide mounting detailed drawing for each security device (physical access control system, intrusion detection, video surveillance and assessment, and intercom systems) for each type of wall and ceiling configuration in project. Device details shall include device, mounting detail, wiring and conduit routing.
- 4) Details of connections to power supplies and grounding
- 5) Details of surge protection device installation
- 6) Sensor detection patterns – Each system sensor shall have associated detection patterns.
- 7) Equipment Rack Detail – For each equipment rack, provide a scaled detail of the equipment rack location and rack space utilization. Use of BISCII wire management standards shall be employed to identify wire management methodology. Transitions between equipment racks shall be shown to include use vertical and horizontal latter rack system.
- 8) Security Control Room – The contractor shall provide a layout plan for the Security Control Room. The layout plan shall identify all equipment and details associated with the installation.
- 9) Operator Console – The contractor shall provide a layout plan for the Operator Console. The layout plan shall identify all equipment and details associated with the installation. Equipment room - the contractor shall provide a layout plan for the equipment room. The layout plan shall identify all equipment and details associated with the installation.
- 10) Equipment Room – Equipment room details shall provide architectural, electrical, mechanical, plumbing, IT/Data and associated equipment and device placements both vertical and horizontally.
- j. Electrical Panel Schedule – Electrical Panel Details shall be provided for all SMS systems electrical power circuits. Panel details shall be provided identifying panel type (Standard, Emergency Power, Emergency/Uninterrupted Power Source, and Uninterrupted Power Source Only), panel location, circuit number, and circuit amperage rating.
- k. Door Schedule – A door schedule shall be developed for each door equipped with electronic security components. At a minimum, the door schedule shall be coordinated with Division 08 work and include the following information:
  - 1) Item Number
  - 2) Door Number (Derived from A/E Drawings)
  - 3) Floor Plan Sheet Number
  - 4) Standard Detail Number
  - 5) Door Description (Derived from Loading Sheets)
  - 6) Data Gathering Panel Input Number
  - 7) Door Position or Monitoring Device Type & Model Number
  - 8) Lock Type, Model Number & Power Input/Draw (standby/active)
  - 9) Card Reader Type & Model Number
  - 10) Shunting Device Type & Model Number
  - 11) Sounder Type & Model Number
  - 12) Manufacturer
  - 13) Misc. devices as required
    - (a) Delayed Egress Type & Model Number
    - (b) Intercom
    - (c) Camera
    - (d) Electric Transfer Hinge
    - (e) Electric Pass-through device
  - 14) Remarks column indicating special notes or door configurations

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2. Camera Schedule - A camera schedule shall be developed for each camera. Contractors shall coordinate with the Resident Engineer to determine camera starting numbers and naming conventions. All drawings shall identify wire and cable standardization methodology. Color coding of all wiring conductors and jackets is required and shall be communicated consistently throughout the drawings package submittal. At a minimum, the camera schedule shall include the following information:
  - a. Item Number
  - b. Camera Number
  - c. Naming Conventions
  - d. Description of Camera Coverage
  - e. Camera Location
  - f. Floor Plan Sheet Number
  - g. Camera Type
  - h. Mounting Type
  - i. Standard Detail Reference
  - j. Power Input & Draw
  - k. Power Panel Location
  - l. Remarks Column for Camera
3. Section II – Data Gathering Panel Documentation Package
  - a. Contractor shall provide Data Gathering Panel (DGP) input and output documentation packages for review at the Shop Drawing submittal stage and also with the as-built documentation package. The documentation packages shall be provided in both printed and magnetic form at both review stages.
  - b. The Contractor shall provide loading sheet documentation package for the associated DGP, including input and output boards for all field panels associated with the project. Documentation shall be provided in current version Microsoft Excel spreadsheets following the format currently utilized by VA. A separate spreadsheet file shall be generated for each DGP and associated field panels.
  - c. The spreadsheet names shall follow a sequence that shall display the spreadsheets in numerical order according to the DGP system number. The spreadsheet shall include the prefix in the file name that uniquely identifies the project site. The spreadsheet shall detail all connected items such as card readers, alarm inputs, and relay output connections. The spreadsheet shall include an individual section (row) for each panel input, output and card reader. The spreadsheet shall automatically calculate the system numbers for card readers, inputs, and outputs based upon data entered in initialization fields.
  - d. All entries must be verified against the field devices. Copies of the floor plans shall be forwarded under separate cover.
  - e. The DGP spreadsheet shall include an entry section for the following information:
    - 1) DGP number
    - 2) First Reader Number
    - 3) First Monitor Point Number
    - 4) First Relay Number
    - 5) DGP, input or output Location
    - 6) DGP Chain Number
    - 7) DGP Cabinet Tamper Input Number
    - 8) DGP Power Fail Input Number
    - 9) Number of Monitor Points Reserved For Expansion Boards
    - 10) Number of Control Points (Relays) Reserved For Expansion Boards
  - f. The DGP, input module and output module spreadsheets shall automatically calculate the following information based upon the associated entries in the above fields:
    - 1) System Numbers for Card Readers

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- 2) System Numbers for Monitor Point Inputs
  - 3) System Numbers for Control Points (Relays)
  - 4) Next DGP or input module First Monitor Point Number
  - 5) Next DGP or output module First Control Point Number
  - g. The DGP spreadsheet shall provide the following information for each card reader:
    - 1) DGP Reader Number
    - 2) System Reader Number
    - 3) Cable ID Number
    - 4) Description Field (Room Number)
    - 5) Description Field (Device Type i.e.: In Reader, Out Reader, etc.)
    - 6) Description Field
    - 7) DGP Input Location
    - 8) Date Test
    - 9) Date Passed
    - 10) Cable Type
    - 11) Camera Numbers (of cameras viewing the reader location)
  - h. The DGP and input module spreadsheet shall provide the following information for each monitor point (alarm input).
    - 1) DGP Monitor Point Input Number
    - 2) System Monitor Point Number
    - 3) Cable ID Number
    - 4) Description Field (Room Number)
    - 5) Description Field (Device Type i.e.: Door Contact, Motion Detector, etc.)
    - 6) DGP or input module Input Location
    - 7) Date Test
    - 8) Date Passed
    - 9) Cable Type
    - 10) Camera Numbers (of associated alarm event preset call-ups)
  - i. The DGP and output module spreadsheet shall provide the following information for each control point (output relay).
    - 1) DGP Control Point (Relay) Number
    - 2) System (Control Point) Number
    - 3) Cable ID Number
    - 4) Description Field (Room Number)
    - 5) Description Field (Device: Lock Control, Local Sounder, etc.)
    - 6) Description Field
    - 7) DGP or OUTPUT MODULE Output Location
    - 8) Date Test
    - 9) Date Passed Cable Type
    - 10) Camera Number (of associated alarm event preset call-ups)
  - j. The DGP, input module and output module spreadsheet shall include the following information or directions in the header and footer:
    - 1) Header
      - (a) DGP Input and Output Worksheet
      - (b) Enter Beginning Reader, Input, and Output Starting Numbers and Sheet Will Automatically Calculate the Remaining System Numbers.
    - 2) Footer
      - (a) File Name
      - (b) Date Printed
      - (c) Page Number
4. Section III - Construction Mock-up: In areas with exposed EMT/Conduit Raceways, contractor shall conceal raceway as much as practical and unobtrusively. In addition,

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- historic significance must be considered to determine installation means and methods for approval by the owner.
5. Section IV - Manufacturers' Data: The data package shall include manufacturers' data for all materials and equipment, including sensors, local processors and console equipment provided under this specification.
  6. Section V - System Description and Analysis: The data package shall include system descriptions, analysis, and calculations used in sizing equipment required by these specifications. Descriptions and calculations shall show how the equipment will operate as a system to meet the performance requirements of this specification. The data package shall include the following:
    - a. Central processor memory size; communication speed and protocol description; rigid disk system size and configuration; flexible disk system size and configuration; back-up media size and configuration; alarm response time calculations; command response time calculations; start-up operations; expansion capability and method of implementation; sample copy of each report specified; and color photographs representative of typical graphics.
    - b. Software Data: The data package shall consist of descriptions of the operation and capability of the system, and application software as specified.
    - c. Overall System Reliability Calculations: The data package shall include all manufacturers' reliability data and calculations required to show compliance with the specified reliability.
  7. Section VI – Certifications & References: All specified manufacturer's certifications shall be included with the data package. Contractor shall provide Project references as outlined in Paragraph 1.4 "Quality Assurance".
- G. Group II Technical Data Package
1. The Contractor shall prepare a report of "Current Site Conditions" and submit a report to the Resident Engineer documenting changes to the site, particularly those conditions that affect performance of the system to be installed. The Contractor shall provide specification sheets, or written functional requirements to support the findings, and a cost estimate to correct those site changes or conditions which affect the installation of the system or its performance. The Contractor shall not correct any deficiency without written permission from the COTR.
  2. System Configuration and Functionality: The contractor shall provide the results of the meeting with VA to develop system requirements and functionality including but not limited to:
    - a. Baseline configuration
    - b. Access levels
    - c. Schedules (intrusion detection, physical access control, holidays, etc.)
    - d. Badge database
    - e. System monitoring and reporting (unit level and central control)
    - f. Naming conventions and descriptors
- H. Group III Technical Data Package
1. Development of Test Procedures: The Contractor will prepare performance test procedures for the system testing. The test procedures shall follow the format of the VA Testing procedures and be customized to the contract requirements. The Contractor will deliver the test procedures to the Resident Engineer for approval at least 60 calendar days prior to the requested test date.
- I. Group IV Technical Data Package
1. Performance Verification Test
    - a. Based on the successful completion of the pre-delivery test, the Contractor shall finalize the test procedures and report forms for the performance verification test (PVT) and the endurance test. The PVT shall follow the format, layout and content of the pre-delivery test. The Contractor shall deliver the PVT and endurance test

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procedures to the Resident Engineer for approval. The Contractor may schedule the PVT after receiving written approval of the test procedures. The Contractor shall deliver the final PVT and endurance test reports within 14 calendar days from completion of the tests. Refer to Part 3 of this section for System Testing and Acceptance requirements.

2. Training Documentation
  - a. New Facilities and Major Renovations: Familiarization training shall be provided for new equipment or systems. Training can include site familiarization training for VA technicians and administrative personnel. Training shall include general information on new system layout including closet locations, turnover of the completed system including all documentation, including manuals, software, key systems, and full system administration rights. Lesson plans and training manuals training shall be oriented to type of training to be provided.
  - b. New Unit Control Room:
    - 1) Provide the security personnel with training in the use, operation, and maintenance of the entire control room system (Unit Control and Equipment Rooms). The training documentation must include the operation and maintenance. The first of the training sessions shall take place prior to system turnover and the second immediately after turnover. Coordinate the training sessions with the Owner. Completed classroom sessions will be witnessed and documented by the Architect/Engineer, and approved by the Resident Engineer. Instruction is not to begin until the system is operational as designed.
    - 2) The training documents will cover the operation and the maintenance manuals and the control console operators' manuals and service manuals in detail, stressing all important operational and service diagnostic information necessary for the maintenance and operations personnel to efficiently use and maintain all systems.
    - 3) Provide an illustrated control console operator's manual and service manual. The operator's manual shall be written in laymen's language and printed so as to become a permanent reference document for the operators, describing all control panel switch operations, graphic symbol definitions and all indicating functions and a complete explanation of all software.
    - 4) The service manual shall be written in laymen's language and printed so as to become a permanent reference document for maintenance personnel, describing how to run internal self diagnostic software programs, troubleshoot head end hardware and field devices with a complete scenario simulation of all possible system malfunctions and the appropriate corrective measures.
    - 5) Provide a professional color DVD instructional recording of all the operational procedures described in the operator's manual. All charts used in the training session shall be clearly presented on the video. Any DVD found to be inferior in recording or material content shall be reproduced at no cost until an acceptable DVD is submitted. Provide four copies of the training DVD, one to the architect/engineer and three to the owner.
3. System Configuration and Data Entry:
  - a. The contractor is responsible for providing all system configuration and data entry for the SMS and subsystems (e.g., video matrix switch, intercom, digital video recorders, network video recorders). All data entry shall be performed per VA standards & guidelines. The Contractor is responsible for participating in all meetings with the client to compile the information needed for data entry. These meetings shall be established at the beginning of the project and incorporated in to the project schedule as a milestone task. The contractor shall be responsible for all data collection, data entry, and system configuration. The contractor shall collect, enter, & program and/or configure the following components:
    - 1) Physical Access control system components,



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- 2) All intrusion detection system components,
  - 3) Video surveillance, control and recording systems,
  - 4) Intercom systems components,
  - 5) All other security subsystems shown in the contract documents.
- b. The Contractor is responsible for compiling the card access database for the VA employees, including programming reader configurations, access shifts, schedules, exceptions, card classes and card enrollment databases.
- c. Refer to Part 3 for system programming requirements and planning guidelines.
4. Graphics: Based on CAD as-built drawings developed for the construction project, create all map sets showing locations of all alarms and field devices. Graphical maps of all alarm points installed under this contract including perimeter and exterior alarm points shall be delivered with the system. The Contractor shall create and install all graphics needed to make the system operational. The Contractor shall utilize data from the contract documents, Contractor's field surveys, and all other pertinent information in the Contractor's possession to complete the graphics. The Contractor shall identify and request from the COTR, any additional data needed to provide a complete graphics package. Graphics shall have sufficient level of detail for the system operator to assess the alarm. The Contractor shall supply hard copy, color examples at least 203.2 x 254 mm (8 x 10 in) of each type of graphic to be used for the completed Security system. The graphics examples shall be delivered to the Resident Engineer for review and approval at least 90 calendar days prior to the scheduled date the Contractor requires them.
- J. Group V Technical Data Package: Final copies of the manuals shall be delivered to the Resident Engineer as part of the acceptance test. The draft copy used during site testing shall be updated with any changes required prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each sub-contractor installing equipment or systems, as well as the nearest service representatives for each item of equipment for each system. The manuals shall include a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the endurance test shall include all modifications made during installation, checkout, and acceptance. //Six (6) hard-copies and one (1) soft copy on CD// of each item listed below shall be delivered as a part of final systems acceptance.
1. Functional Design Manual: The functional design manual shall identify the operational requirements for the entire system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included for all system operating modes. Manufacturer developed literature may be used; however, shall be produced to match the project requirements.
  2. Equipment Manual: A manual describing all equipment furnished including:
    - a. General description and specifications; installation and checkout procedures; equipment electrical schematics and layout drawings; system schematics and layout drawings; alignment and calibration procedures; manufacturer's repair list indicating sources of supply; and interface definition.
  3. Software Manual: The software manual shall describe the functions of all software and include all other information necessary to enable proper loading, testing, and operation. The manual shall include:
    - a. Definition of terms and functions; use of system and applications software; procedures for system initialization, start-up, and shutdown; alarm reports; reports generation, database format and data entry requirements; directory of all disk files; and description of all communications protocols including data formats, command characters, and a sample of each type of data transfer.
  4. Operator's Manual: The operator's manual shall fully explain all procedures and instructions for the operation of the system, including:
    - a. Computers and peripherals; system start-up and shutdown procedures; use of system, command, and applications software; recovery and restart procedures;

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- graphic alarm presentation; use of report generator and generation of reports; data entry; operator commands' alarm messages, and printing formats; and system access requirements.
5. Maintenance Manual: The maintenance manual shall include descriptions of maintenance for all equipment including inspection, recommend schedules, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.
  6. Spare Parts & Components Data: At the conclusion of the Contractor's work, the Contractor shall submit to the Resident Engineer a complete list of the manufacturer's recommended spare parts and components required to satisfactorily maintain and service the systems, as well as unit pricing for those parts and components.
  7. Operation, Maintenance & Service Manuals: The Contractor shall provide two (2) complete sets of operating and maintenance manuals in the form of an instructional manual for use by the VA Security Guard Force personnel. The manuals shall be organized into suitable sets of manageable size. Where possible, assemble instructions for similar equipment into a single binder. If multiple volumes are required, each volume shall be fully indexed and coordinated.
  8. Equipment and Systems Maintenance Manual: The Contractor shall provide the following descriptive information for each piece of equipment, operating system, and electronic system:
    - a. Equipment and/or system function.
    - b. Operating characteristics.
    - c. Limiting conditions.
    - d. Performance curves.
    - e. Engineering data and test.
    - f. Complete nomenclature and number of replacement parts.
    - g. Provide operating and maintenance instructions including assembly drawings and diagrams required for maintenance and a list of items recommended to stock as spare parts.
    - h. Provide information detailing essential maintenance procedures including the following: routine operations, trouble shooting guide, disassembly, repair and re-assembly, alignment, adjusting, and checking.
    - i. Provide information on equipment and system operating procedures, including the following; start-up procedures, routine and normal operating instructions, regulation and control procedures, instructions on stopping, shut-down and emergency instructions, required sequences for electric and electronic systems, and special operating instructions.
    - j. Manufacturer equipment and systems maintenance manuals are permissible.
  9. Project Redlines: During construction, the Contractor shall maintain an up-to-date set of construction redlines detailing current location and configuration of the project components. The redline documents shall be marked with the words 'Master Redlines' on the cover sheet and be maintained by the Contractor in the project office. The Contractor will provide access to redline documents anytime during the project for review and inspection by the Resident Engineer or authorized Office of Protection Services representative. Master redlines shall be neatly maintained throughout the project and secured under lock and key in the contractor's onsite project office. Any project component or assembly that is not installed in strict accordance with the drawings shall be so noted on the drawings. Prior to producing Record Construction Documents, the contractor will submit the Master Redline document to the Resident Engineer for review and approval of all changes or modifications to the documents. Each sheet shall have Resident Engineer initials indicating authorization to produce "As Built" documents. Field drawings shall be used for data gathering & field changes. These changes shall be made to the master redline documents daily. Field drawings shall not be considered "master redlines".

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10. Record Specifications: The Contractor shall maintain one (1) copy of the Project Specifications, including addenda and modifications issued, for Project Record Documents. The Contractor shall mark the Specifications to indicate the actual installation where the installation varies substantially from that indicated in the Contract Specifications and modifications issued. (Note related Project Record Drawing information where applicable). The Contractor shall pay particular attention to substitutions, selection of product options, and information on concealed installations that would be difficult to identify or measure and record later. Upon completion of the mark ups, the Contractor shall submit record Specifications to the COTR. As with master relines, Contractor shall maintain record specifications for Resident Engineer review and inspection at anytime.
11. Record Product Data: The Contractor shall maintain one (1) copy of each Product Data submittal for Project Record Document purposes. The Data shall be marked to indicate the actual product installed where the installation varies substantially from that indicated in the Product Data submitted. Significant changes in the product delivered to the site and changes in manufacturer's instructions and recommendations for installation shall be included. Particular attention will be given to information on concealed products and installations that cannot be readily identified or recorded later. Note related Change Orders and mark up of Record Construction Documents, where applicable. Upon completion of mark up, submit a complete set of Record Product Data to the COTR.
12. Miscellaneous Records: The Contractor shall maintain one (1) copy of miscellaneous records for Project Record Document purposes. Refer to other Specifications for miscellaneous record-keeping requirements and submittals concerning various construction activities. Before substantial completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for use and reference. Categories of requirements resulting in miscellaneous records include a minimum of the following:
  - a. Certificates received instead of labels on bulk products.
  - b. Testing and qualification of tradesmen. ("Contractor's Qualifications")
  - c. Documented qualification of installation firms.
  - d. Load and performance testing.
  - e. Inspections and certifications.
  - f. Final inspection and correction procedures.
  - g. Project schedule
13. Record Construction Documents (Record As-Built)
  - a. Upon project completion, the contractor shall submit the project master redlines to the Resident Engineer prior to development of Record construction documents. The Resident Engineer shall be given a minimum of a thirty (30) day review period to determine the adequacy of the master redlines. If the master redlines are found suitable by the Resident Engineer, the Resident Engineer will initial and date each sheet and turn redlines over to the contractor for as built development.
  - b. The Contractor shall provide the Resident Engineer a complete set of "as-built" drawings and original master redlined marked "as-built" blue-line in the latest version of AutoCAD drawings unlocked on CD or DVD. The as-built drawing shall include security device number, security closet connection location, data gathering panel number, and input or output number as applicable. All corrective notations made by the Contractor shall be legible when submitted to the COTR. If, in the opinion of the COTR, any redlined notation is not legible, it shall be returned to the Contractor for re-submission at no extra cost to the Owner. The Contractor shall organize the Record Drawing sheets into manageable sets bound with durable paper cover sheets with suitable titles, dates, and other identifications printed on the cover. The submitted as built shall be in editable formats and the ownership of the drawings shall be fully relinquished to the owner.
  - c. Where feasible, the individual or entity that obtained record data, whether the individual or entity is the installer, sub-contractor, or similar entity, is required to

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prepare the mark up on Record Drawings. Accurately record the information in a comprehensive drawing technique. Record the data when possible after it has been obtained. For concealed installations, record and check the mark up before concealment. At the time of substantial completion, submit the Record Construction Documents to the COTR. The Contractor shall organize into bound and labeled sets for the COTR's continued usage. Provide device, conduit, and cable lengths on the conduit drawings. Exact in-field conduit placement/routings shall be shown. All conduits shall be illustrated in their entire length from termination in security closets; no arrowed conduit runs shall be shown. Pull box and junction box sizes are to be shown if larger than 100mm (4 inch).

- K. FIPS 201 Compliance Certificates
  - 1. Provide Certificates for all software components and device types utilizing credential verification. Provide certificates for:
    - a. Fingerprint Capture Station
    - b. Card Readers
    - c. Facial Image Capturing Camera
    - d. PIV Middleware
    - e. Template Matcher
    - f. Electromagnetically Opaque Sleeve
    - g. Certificate Management
      - 1) CAK Authentication System
      - 2) PIV Authentication System
      - 3) Certificate Validator
      - 4) Cryptographic Module
- L. Approvals will be based on complete submission of manuals together with shop drawings.
- M. After approval and prior to installation, furnish the Resident Engineer with one sample of each of the following:
  - 1. A 300 mm (12 inch) length of each type and size of wire and cable along with the tag from the coils of reels from which the samples were taken.
  - 2. Each type of conduit and pathway coupling, bushing and termination fitting.
  - 3. Conduit hangers, clamps and supports.
  - 4. Duct sealing compound.
- N. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.
- O. In addition to the requirement of SUBMITTALS, the VA reserves the right to request the manufacturer to arrange for a VA representative to see typical active systems in operation, when there has been no prior experience with the manufacturer or the type of equipment being submitted.//

**1.07 APPLICABLE PUBLICATIONS**

- A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI)/ International Code Council (ICC):
  - 1. A117.1 - Standard on Accessible and Usable Buildings and Facilities
- C. American National Standards Institute (ANSI)/ Security Industry Association (SIA):
  - 1. AC-02 - Access Control: Access Control Guideline Dye Sublimation Printing Practices for PVC Access Control Cards
  - 2. CP-01-00 - Control Panel Standard-Features for False Alarm Reduction

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3. PIR-01-00 - Passive Infrared Motion Detector Standard - Features for Enhancing False Alarm Immunity
4. TVAC-01 - CCTV to Access Control Standard - Message Set for System Integration
- D. American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA):
  1. 330-09 - Electrical Performance Standards for CCTV Cameras
  2. 375A-76 - Electrical Performance Standards for CCTV Monitors
- E. American National Standards Institute (ANSI):
  1. ANSI S3.2-99 - Method for measuring the Intelligibility of Speech over Communications Systems
- F. American Society for Testing and Materials (ASTM)
  1. B1-07 - Standard Specification for Hard-Drawn Copper Wire
  2. B3-07 - Standard Specification for Soft or Annealed Copper Wire
  3. B8-04 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
  4. C1238-97 (R03) - Standard Guide for Installation of Walk-Through Metal Detectors
  5. D2301-04 - Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape
- G. Architectural Barriers Act (ABA), 1968
- H. Department of Justice: American Disability Act (ADA)
  1. 28 CFR Part 36-2010 ADA Standards for Accessible Design
- I. Department of Veterans Affairs:
  1. VHA National CAD Standard Application Guide, 2006
  2. VA BIM Guide, V1.0 10
- J. Federal Communications Commission (FCC):
  1. (47 CFR 15) Part 15 - Limitations on the Use of Wireless Equipment/Systems
- K. Federal Information Processing Standards (FIPS):
  1. FIPS-201-1 - Personal Identity Verification (PIV) of Federal Employees and Contractors
- L. Federal Specifications (Fed. Spec.):
  1. A-A-59544 - Cable and Wire, Electrical (Power, Fixed Installation)
- M. Government Accountability Office (GAO):
  1. GAO-03-8-02 - Security Responsibilities for Federally Owned and Leased Facilities
- N. Homeland Security Presidential Directive (HSPD):
  1. HSPD-12 - Policy for a Common Identification Standard for Federal Employees and Contractors
- O. Institute of Electrical and Electronics Engineers (IEEE):
  1. 81-1983 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
  2. 802.3af-08 - Power over Ethernet Standard
  3. 802.3at-09 - Power over Ethernet (PoE) Plus Standard
  4. C2-07 -- National Electrical Safety Code
  5. C62.41-02 - IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits
  6. C95.1-05 - Standards for Safety Levels with Respect to Human Exposure in Radio Frequency Electromagnetic Fields
- P. International Organization for Standardization (ISO):
  1. 7810 - Identification cards – Physical characteristics
  2. 7811 - Physical Characteristics for Magnetic Stripe Cards

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3. 7816-1 - Identification cards - Integrated circuit(s) cards with contacts - Part 1: Physical characteristics
  4. 7816-2 - Identification cards - Integrated circuit cards - Part 2: Cards with contacts - Dimensions and location of the contacts
  5. 7816-3 - Identification cards - Integrated circuit cards - Part 3: Cards with contacts - Electrical interface and transmission protocols
  6. 7816-4 - Identification cards - Integrated circuit cards - Part 11: Personal verification through biometric methods
  7. 7816-10 - Identification cards - Integrated circuit cards - Part 4: Organization, security and commands for interchange
  8. 14443 - Identification cards - Contactless integrated circuit cards; Contactless Proximity Cards Operating at 13.56 MHz in up to 5 inches distance
  9. 15693 - Identification cards -- Contactless integrated circuit cards - Vicinity cards; Contactless Vicinity Cards Operating at 13.56 MHz in up to 50 inches distance
  10. 19794 - Information technology - Biometric data interchange formats
- Q. National Electrical Contractors Association
1. 303-2005 - Installing Closed Circuit Television (CCTV) Systems
- R. National Electrical Manufacturers Association (NEMA):
1. 250-08 - Enclosures for Electrical Equipment (1000 Volts Maximum)
  2. TC-3-04 - PVC Fittings for Use with Rigid PVC Conduit and Tubing
  3. FBI-07 - Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
- S. National Fire Protection Association (NFPA):
1. 70-11 - National Electrical Code (NEC)
  2. 731-08 - Standards for the Installation of Electric Premises Security Systems
  3. 99-2005 - Health Care Facilities
- T. National Institute of Justice (NIJ)
1. 0601.02-03 - Standards for Walk-Through Metal Detectors for use in Weapons Detection
  2. 0602.02-03 - Hand-Held Metal Detectors for Use in Concealed Weapon and Contraband Detection
- U. National Institute of Standards and Technology (NIST):
1. IR 6887 V2.1 - Government Smart Card Interoperability Specification (GSC-IS)
  2. Special Pub 800-37 - Guide for Applying the Risk Management Framework to Federal Information Systems
  3. Special Pub 800-63 - Electronic Authentication Guideline
  4. Special Pub 800-73-3 - Interfaces for Personal Identity Verification (4 Parts)
    - a. Pt. 1- End Point PIV Card Application Namespace, Data Model & Representation
    - b. Pt. 2- PIV Card Application Card Command Interface
    - c. Pt. 3- PIV Client Application Programming Interface
    - d. Pt. 4- The PIV Transitional Interfaces & Data Model Specification
  5. Special Pub 800-76-1 - Biometric Data Specification for Personal Identity Verification
  6. Special Pub 800-78-2 - Cryptographic Algorithms and Key Sizes for Personal Identity Verification
  7. Special Pub 800-79-1 - Guidelines for the Accreditation of Personal Identity Verification Card Issuers
  8. Special Pub 800-85B-1 - DRAFTPIV Data Model Test Guidelines
  9. Special Pub 800-85A-2 - PIV Card Application and Middleware Interface Test Guidelines (SP 800-73-3 compliance)
  10. Special Pub 800-96 - PIV Card Reader Interoperability Guidelines
  11. Special Pub 800-104A - Scheme for PIV Visual Card Topography
- V. Occupational and Safety Health Administration (OSHA):

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1. 29 CFR 1910.97 - Nonionizing radiation
- W. Section 508 of the Rehabilitation Act of 1973
- X. Security Industry Association (SIA):
  1. AG-01 - Security CAD Symbols Standards
- Y. Underwriters Laboratories, Inc. (UL):
  1. 1-05 - Flexible Metal Conduit
  2. 5-04 - Surface Metal Raceway and Fittings
  3. 6-07 - Rigid Metal Conduit
  4. 44-05 - Thermoset-Insulated Wires and Cables
  5. 50-07 - Enclosures for Electrical Equipment
  6. 83-08 - Thermoplastic-Insulated Wires and Cables
  7. 294-99 - The Standard of Safety for Access Control System Units
  8. 305-08 - Standard for Panic Hardware
  9. 360-09 - Liquid-Tight Flexible Steel Conduit
  10. 444-08 - Safety Communications Cables
  11. 464-09 - Audible Signal Appliances
  12. 467-07 - Electrical Grounding and Bonding Equipment
  13. 486A-03 - Wire Connectors and Soldering Lugs for Use with Copper Conductors
  14. 486C-04 - Splicing Wire Connectors
  15. 486D-05 - Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations
  16. 486E-00 - Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
  17. 493-07 - Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable
  18. 514A-04 - Metallic Outlet Boxes
  19. 514B-04 - Fittings for Cable and Conduit
  20. 51-05 - Schedule 40 and 80 Rigid PVC Conduit
  21. 609-96 - Local Burglar Alarm Units and Systems
  22. 634-07 - Standards for Connectors with Burglar-Alarm Systems
  23. 636-01 - Standard for Holdup Alarm Units and Systems
  24. 639-97 - Standard for Intrusion-Detection Units
  25. 651-05 - Schedule 40 and 80 Rigid PVC Conduit
  26. 651A-07 - Type EB and A Rigid PVC Conduit and HDPE Conduit
  27. 752-05 - Standard for Bullet-Resisting Equipment
  28. 797-07 - Electrical Metallic Tubing
  29. 827-08 - Central Station Alarm Services
  30. 1037-09 - Standard for Anti-theft Alarms and Devices
  31. 1635-10 - Digital Alarm Communicator System Units
  32. 1076-95 - Standards for Proprietary Burglar Alarm Units and Systems
  33. 1242-06 - Intermediate Metal Conduit
  34. 1479-03 - Fire Tests of Through-Penetration Fire Stops
  35. 1981-03 - Central Station Automation System
  36. 2058-05 - High Security Electronic Locks
  37. 60950 - Safety of Information Technology Equipment
  38. 60950-1 - Information Technology Equipment - Safety - Part 1: General Requirements
- Z. Uniform Federal Accessibility Standards (UFAS) 1984
- AA. United States Department of Commerce:
  1. Special Pub 500-101 - Care and Handling of Computer Magnetic Storage Media

**1.08 COORDINATION**

- A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:

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1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  3. To allow right of way for piping and conduit installed at required slope.
  4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed.

### **1.09 MAINTENANCE & SERVICE**

- A. General Requirements
1. The Contractor shall provide all services required and equipment necessary to maintain the entire integrated electronic security system in an operational state as specified for a period of one (1) year after formal written acceptance of the system. The Contractor shall provide all necessary material required for performing scheduled adjustments or other non-scheduled work. Impacts on facility operations shall be minimized when performing scheduled adjustments or other non-scheduled work. See also General Project Requirements.
- B. Description of Work
1. The adjustment and repair of the security system includes all software updates, panel firmware, and the following new items computers equipment, communications transmission equipment and data transmission media (DTM), local processors, security system sensors, physical access control equipment, facility interface, signal transmission equipment, and video equipment.
- C. Personnel
1. Service personnel shall be certified in the maintenance and repair of the selected type of equipment and qualified to accomplish all work promptly and satisfactorily. The Resident Engineer shall be advised in writing of the name of the designated service representative, and of any change in personnel. The Resident Engineer shall be provided copies of system manufacturer certification for the designated service representative.
- D. Schedule of Work
1. The work shall be performed during regular working hours, Monday through Friday, excluding federal holidays.
- E. System Inspections
1. These inspections shall include:
    - a. The Contractor shall perform two (2) minor inspections at six (6) month intervals or more if required by the manufacturer, and two (2) major inspections offset equally between the minor inspections to effect quarterly inspection of alternating magnitude.
      - 1) Minor Inspections shall include visual checks and operational tests of all console equipment, peripheral equipment, local processors, sensors, electrical and mechanical controls, and adjustments on printers.
      - 2) Major Inspections shall include all work described for Minor Inspections and the following: clean all system equipment and local processors including interior and exterior surfaces; perform diagnostics on all equipment; operational tests of the CPU, switcher, peripheral equipment, recording devices, monitors, picture quality from each camera; check, walk test, and calibrate each sensor; run all system software diagnostics and correct all problems; and resolve any previous outstanding problems.
- F. Emergency Service



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1. The owner shall initiate service calls whenever the system is not functioning properly. The Contractor shall provide the Owner with an emergency service center telephone number. The emergency service center shall be staffed 24 hours a day 365 days a year. The Owner shall have sole authority for determining catastrophic and non-catastrophic system failures within parameters stated in General Project Requirements.
  - a. For catastrophic system failures, the Contractor shall provide same day four (4) hour service response with a defect correction time not to exceed eight (8) hours from [notification] [arrival on site]. Catastrophic system failures are defined as any system failure that the Owner determines will place the facility(s) at increased risk.
  - b. For non-catastrophic failures, the Contractor within eight (8) hours with a defect correction time not to exceed 24 hours from notification.
- G. Operation
  1. Performance of scheduled adjustments and repair shall verify operation of the system as demonstrated by the applicable portions of the performance verification test.
- H. Records & Logs
  1. The Contractor shall maintain records and logs of each task and organize cumulative records for each component and for the complete system chronologically. A continuous log shall be submitted for all devices. The log shall contain all initial settings, calibration, repair, and programming data. Complete logs shall be maintained and available for inspection on site, demonstrating planned and systematic adjustments and repairs have been accomplished for the system.
- I. Work Request
  1. The Contractor shall separately record each service call request, as received. The record shall include the serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing the action taken, the amount and nature of the materials used, and the date and time of commencement and completion. The Contractor shall deliver a record of the work performed within five (5) working days after the work was completed.
- J. System Modifications
  1. The Contractor shall make any recommendations for system modification in writing to the Resident Engineer. No system modifications, including operating parameters and control settings, shall be made without prior written approval from the Resident Engineer. Any modifications made to the system shall be incorporated into the operation and maintenance manuals and other documentation affected.
- K. Software
  1. The Contractor shall provide all software updates when approved by the Owner from the manufacturer during the installation and 12-month warranty period and verify operation of the system. These updates shall be accomplished in a timely manner, fully coordinated with the system operators, and incorporated into the operations and maintenance manuals and software documentation. There shall be at least one (1) scheduled update near the end of the first year's warranty period, at which time the Contractor shall install and validate the latest released version of the Manufacturer's software. All software changes shall be recorded in a log maintained in the unit control room. An electronic copy of the software update shall be maintained within the log. At a minimum, the contractor shall provide a description of the modification, when the modification occurred, and name and contact information of the individual performing the modification. The log shall be maintained in a white 3 ring binder and the cover marked "SOFTWARE CHANGE LOG".

#### 1.10 MINIMUM REQUIREMENTS

- A. References to industry and trade association standards and codes are minimum installation requirement standards.

- B. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

#### 1.11 DELIVERY, STORAGE, & HANDLING

- A. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:
  - 1. During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing and operating and repainting if required.
  - 2. Damaged equipment shall be, as determined by the Resident Engineer, placed in first class operating condition or be returned to the source of supply for repair or replacement.
  - 3. Painted surfaces shall be protected with factory installed removable heavy craft paper, sheet vinyl or equal.
  - 4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.
- B. Central Station, Workstations, and Controllers:
  - 1. Store in temperature and humidity controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 10 to 30 deg C (50 to 85 deg F), and not more than 80 percent relative humidity, non-condensing.
  - 2. Open each container; verify contents against packing list, and file copy of packing list, complete with container identification for inclusion in operation and maintenance data.
  - 3. Mark packing list with designations which have been assigned to materials and equipment for recording in the system labeling schedules generated by cable and asset management system.
  - 4. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

#### 1.12 PROJECT CONDITIONS

- A. Environmental Conditions: System shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
  - 1. Interior, Controlled Environment: System components, except central-station control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of 2 to 50 deg C (36 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, non-condensing. NEMA 250, Type 1 enclosure.
  - 2. Interior, Uncontrolled Environment: System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of -18 to 50 deg C (0 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, non-condensing. NEMA 250, Type 4X enclosures.
  - 3. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of -34 to 50 deg C (-30 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation where exposed to rain as specified in NEMA 250, winds up to 137 km/h (85 mph) and snow cover up to 610 mm (24 in) thick. NEMA 250, Type 4X enclosures.
  - 4. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.
  - 5. Corrosive Environment: For system components subjected to corrosive fumes, vapors, and wind-driven salt spray in coastal zones, provide NEMA 250, Type 4X enclosures.
- B. Security Environment: Use vandal resistant enclosures in high-risk areas where equipment may be subject to damage.
- C. Console: All console equipment shall, unless noted otherwise, be rated for continuous operation under ambient environmental conditions of 15.6 to 29.4 deg C (60 to 85 deg F) and a

relative humidity of 20 to 80 percent.

### 1.13 EQUIPMENT AND MATERIALS

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.
- B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
  - 1. Components of an assembled unit need not be products of the same manufacturer.
  - 2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
  - 3. Components shall be compatible with each other and with the total assembly for the intended service.
  - 4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Testing Is Specified:
  - 1. The Government shall have the option of witnessing factory tests. The contractor shall notify the VA through the Resident Engineer a minimum of 15 working days prior to the manufacturers making the factory tests.
  - 2. Four copies of certified test reports containing all test data shall be furnished to the Resident Engineer prior to final inspection and not more than 90 days after completion of the tests.
  - 3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the Government.

### 1.14 ELECTRICAL POWER

- A. Electrical power of 120 Volts Alternating Current (VAC) shall be indicated on the Division 26 drawings. Additional locations requiring primary power required by the security system shall be shown as part of these contract documents. Primary power for the security system shall be configured to switch to emergency backup sources automatically if interrupted without degradation of any critical system function. Alarms shall not be generated as a result of power switching, however, an indication of power switching on (on-line source) shall be provided to the alarm monitor. The Security Contractor shall provide an interface (dry contact closure) between the PACS and the Uninterruptible Power Supply (UPS) system so the UPS trouble signals and main power fail appear on the PACS operator terminal as alarms.
- B. Failure of any on-line battery shall be detected and reported as a fault condition. Battery backed-up power supplies shall be provided sized for [8] hours of operation at actual connected load. Requirements for additional power or locations shall be included with the contract to support equipment and systems offered. The following minimum requirements shall be provided for power sources and equipment.
  - 1. Emergency Generator
    - a. Report Printers: Unit Control Room
    - b. Video Monitors: Unit Control Room
    - c. Intercom Stations
    - d. Radio System
    - e. Lights: Unit Control Room, Equipment Rooms, & Security Offices
    - f. Outlets: Security Outlets dedicated to security equipment racks or security enclosure assemblies.
    - g. Security Device Power Supplies (DGP, VASS, Card Access, Lock Power, etc.) powered from the security closets or remotely: various locations
    - h. Telephone/Radio Recording Equipment: Unit Control Room.
    - i. VASS Camera Power Supplies: Security Closets

- j. VASS Pan/Tilt Units: Various Locations
  - k. VASS Outdoor Housing Heaters and Blowers: Various Sites
  - l. Intercom Master Control System
  - m. Fiber Optic Receivers/Transmitters
  - n. Security office Weapons Storage
  - o. Outlets that charge handheld radios
2. Uninterruptible Power Supply (UPS) on Emergency Power
- a. The following 120VAC circuits shall be provided by others. The Security Contractor shall coordinate exact locations with the Electrical Contractor:
    - 1) Security System Monitors and Keyboards: Control Room
    - 2) CPU: Control Equipment Room
    - 3) Communications equipment: Control Equipment Room and various sites.
    - 4) VASS Matrix Switcher: Control Equipment Room
    - 5) VASS: Control Equipment Room
    - 6) Digital Video Recorders, encoders & decoders: Control Room
    - 7) All equipment Room racked equipment.
    - 8) Network switches

#### **1.15 TRANSIENT VOLTAGE SUPPRESSION, POWER SURGE SUPPLESION, & GROUNDING**

- A. Transient Voltage Surge Suppression: All cables and conductors extending beyond building façade, except fiber optic cables, which serve as communication, control, or signal lines shall be protected against Transient Voltage surges and have Transient Voltage Surge Suppression (TVSS) protection. The TVSS device shall be UL listed in accordance with Standard TIA 497B installed at each end. Lighting and surge suppression shall be a multi-strike variety and include a fault indicator. Protection shall be furnished at the equipment and additional triple solid state surge protectors rated for the application on each wire line circuit shall be installed within 914.4 mm (3 ft) of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode to verify there is no interference.
- 1. A 10-microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
  - 2. An 8-microsecond rise time by 20-microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.
  - 3. Maximum series current: 2 AMPS. Provide units manufactured by Advanced Protection Technologies, model # TE/FA 10B or TE/FA 20B.
  - 4. Operating Temperature and Humidity: -40 to 85 deg C (-40 to 185 deg F), 0 to 95 percent relative humidity.
- B. Grounding and Surge Suppression
- 1. The Security Contractor shall provide grounding and surge suppression to stabilize the voltage under normal operating conditions. To ensure the operation of over current devices, such as fuses, circuit breakers, and relays, under ground-fault conditions.
  - 2. Security Contractor shall engineer and provide proper grounding and surge suppression as required by local jurisdiction and prevailing codes and standards referenced in this document.
  - 3. Principal grounding components and features. Include main grounding buses and grounding and bonding connections to service equipment.
  - 4. Details of interconnection with other grounding systems. The lightning protection system shall be provided by the Security Contractor.
  - 5. Locations and sizes of grounding conductors and grounding buses in electrical, data, and communication equipment rooms and closets.
  - 6. AC power receptacles are not to be used as a ground reference point.
  - 7. Any cable that is shielded shall require a ground in accordance with the best practices of the trade and manufactures installation instructions.

8. Protection should be provided at both ends of cabling.

### 1.16 COMPONENT ENCLOSURES

- A. Construction of Enclosures
  1. Consoles, power supply enclosures, detector control and terminal cabinets, control units, wiring gutters, and other component housings, collectively referred to as enclosures, shall be so formed and assembled as to be sturdy and rigid.
  2. Thickness of metal in-cast and sheet metal enclosures of all types shall not be less than those in Tables I and II, UL 611. Sheet steel used in fabrication of enclosures shall be not less than 14 gauge. Consoles shall be 16-gauge.
  3. Doors and covers shall be flanged. Enclosures shall not have pre-punched knockouts. Where doors are mounted on hinges with exposed pins, the hinges shall be of the tight pin type or the ends of hinge pins shall be tack welded to prevent removal. Doors having a latch edge length of less than 609.6 mm (24 in) shall be provided with a single construction core. Where the latch edge of a hinged door is more than 609.6 mm (24 in) or more in length, the door shall be provided with a three-point latching device with construction core; or alternatively with two, one located near each end.
  4. Any ventilator openings in enclosures and cabinets shall conform to the requirements of UL 611. Unless otherwise indicated, sheet metal enclosures shall be designed for wall mounting with tip holes slotted. Mounting holes shall be in positions that remain accessible when all major operating components are in place and the door is open, but shall be in accessible when the door is closed.
  5. Covers of pull and junction boxes provided to facilitate initial installation of the system shall be held in place by tamper proof Torx Center post security screws. Stenciled or painted labels shall be affixed to such boxes indicating they contain no connections. These labels shall not indicate the box is part of the Electronic Security System (ESS).
- B. Consoles & Equipment Racks: All consoles and vertical equipment racks shall include a forced air-cooling system to be provided by others.
  1. Vertical Equipment Racks:
    - a. The forced air blowers shall be installed in the vented top of each cabinet and shall not reduce usable rack space.
    - b. The forced air fan shall consist of one fan rated at 105 CFM per rack bay and noise level shall not exceed 55 decibels.
    - c. d. Vertical equipment racks are to be provided with full sized clear plastic locking doors and vented top panels as shown on contract drawings.
  2. Console racks:
    - a. Forced air fans shall be installed in the top rear of each console bay. The forced air fan shall consist of one fan rated at 105 CFM mounted to a 133mm vented blank panel the noise level of each fan shall not exceed 55 decibels. The fans shall be installed so air is pulled from the bottom of the rack or cabinet and exhausted out the top.
    - b. Console racks are to be provided with flush mounted hinged rear doors with recessed locking latch on the bottom and middle sections of the consoles. Provide code access to support wiring for devices located on the work surfaces.
- C. Tamper Provisions and Tamper Switches:
  1. Enclosures, cabinets, housings, boxes and fittings or every product description having hinged doors or removable covers and which contain circuits, or the integrated security system and its power supplies shall be provided with cover operated, corrosion-resistant tamper switches.
  2. Tamper switches shall be arranged to initiate an alarm signal that will report to the monitoring station when the door or cover is moved. Tamper switches shall be mechanically mounted to maximize the defeat time when enclosure covers are opened or removed. It shall take longer than 1 second to depress or defeat the tamper switch after

opening or removing the cover. The enclosure and tamper switch shall function together in such a manner as to prohibit direct line of sight to any internal component before the switch activates.

3. Tamper switches shall be inaccessible until the switch is activated. Have mounting hardware concealed so the location of the switch cannot be observed from the exterior of the enclosure. Be connected to circuits which are under electrical supervision at all times, irrespective of the protection mode in which the circuit is operating. Be spring-loaded and held in the closed position by the door or cover and be wired so they break the circuit when the door cover is disturbed. Tamper circuits shall be adjustable type screw sets and shall be adjusted by the contractor to eliminate nuisance alarms associated with incorrectly mounted tamper device shall annunciate prior to the enclosure door opening (within 1/4 - inch tolerance. The tamper device or its components shall not be visible or accessible with common tools to bypass when the enclosure is in the secured mode.
4. The single gang junction boxes for the portrait alarming and pull boxes with less than 102 square mm will not require tamper switches.
5. All enclosures over 305 square mm shall be hinged with an enclosure lock.
6. Control Enclosures: Maintenance/Safety switches on control enclosures, which must be opened to make routing maintenance adjustments to the system and to service the power supplies, shall be push/pull-set automatic reset type.
7. Provide one (1) enclosure tamper switch for each 609 linear mm of enclosure lock side opening evenly spaced.
8. All security screws shall be Torx-Post Security Screws.
9. The contractor shall provide the owner with two (2) torx-post screwdrivers.

#### **1.17 ELECTRONIC COMPONENTS**

- A. All electronic components of the system shall be of the solid-state type, mounted on printed circuit boards conforming to UL 796. Boards shall be plug-in, quick-disconnect type. Circuitry shall not be so densely placed as to impede maintenance. All power-dissipating components shall incorporate safety margins of not less than 25 percent with respect to dissipation ratings, maximum voltages, and current-carrying capacity.

#### **1.18 SUBSTITUTE MATERIALS & EQUIPMENT**

- A. Where variations from the contract requirements are requested in accordance with the GENERAL CONDITIONS and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.
- B. In addition to this Section the Security Contractor shall also reference Section II, Products and associated divisions. The Resident Engineer shall have final authority on the authorization or refusal of substitutions. If there are no proposed substitutions, a statement in writing from the Contractor shall be submitted to the Resident Engineer stating same. In the preparation of a list of substitutions, the following information shall be included, as a minimum:
  1. Identity of the material or devices specified for which there is a proposed substitution.
  2. Description of the segment of the specification where the material or devices are referenced.
  3. Identity of the proposed substitute by manufacturer, brand name, catalog or model number and the manufacturer's product name.
  4. A technical statement of all operational characteristic expressing equivalence to items to be substituted and comparison, feature-by-feature, between specification requirements and the material or devices called for in the specification; and Price differential.
- C. Materials Not Listed: Furnish all necessary hardware, software, programming materials, and supporting equipment required to place the specified major subsystems in full operation. Note that some supporting equipment, materials, and hardware may not be described herein. Depending on the manufacturers selected by the COTR, some equipment, materials and

hardware may not be contained in either the Contract Documents or these written specifications, but are required by the manufacturer for complete operation according to the intent of the design and these specifications. In such cases, the Resident Engineer shall be given the opportunity to approve the additional equipment, hardware and materials that shall be fully identified in the bid and in the equipment list submittal. The Resident Engineer shall be consulted in the event there is any question about which supporting equipment, materials, or hardware is intended to be included.

- D. Response to Specification: The Contractor shall submit a point-by-point statement of compliance with each paragraph of the security specification. The statement of compliance shall list each paragraph by number and indicate "COMPLY" opposite the number for each paragraph where the Contractor fully complies with the specification. Where the proposed system cannot meet the requirements of the paragraph, and does not offer an equivalent solution, the offers shall indicate "DOES NOT COMPLY" opposite the paragraph number. Where the proposed system does not comply with the paragraph as written, but the bidder feels it will accomplish the intent of the paragraph in a manner different from that described, the offers shall indicate "COMPARABLE". The offers shall include a statement fully describing the "comparable" method of satisfying the requirement. Where a full and concise description is not provided, the offered system shall be considered as not complying with the specification. Any submission that does not include a point-by-point statement of compliance, as described above, shall be disqualified. Submittals for products shall be in precise order with the product section of the specification. Submittals not in proper sequence will be rejected.

#### **1.19 LIKE ITEMS**

- A. Where two or more items of equipment performing the same function are required, they shall be exact duplicates produced by one manufacturer. All equipment provided shall be complete, new, and free of any defects.

#### **1.20 WARRANTY**

- A. The Contractor shall, as a condition precedent to the final payment, execute a written guarantee (warranty) to the COTR certifying all contract requirements have been completed according to the final specifications. Contract drawings and the warranty of all materials and equipment furnished under this contract are to remain in satisfactory operating condition (ordinary wear and tear, abuse and causes beyond his control for this work accepted) for one (1) year from the date the Contractor received written notification of final acceptance from the COTR. Demonstration and training shall be performed prior to system acceptance. All defects or damages due to faulty materials or workmanship shall be repaired or replaced without delay, to the COTR's satisfaction, and at the Contractor's expense. The Contractor shall provide quarterly inspections during the warranty period. The contractor shall provide written documentation to the COTR on conditions and findings of the system and device(s). In addition, the contractor shall provide written documentation of test results and stating what was done to correct any deficiencies. The first inspection shall occur 90 calendar days after the acceptance date. The last inspection shall occur 30 calendar days prior to the end of the warranty. The warranty period shall be extended until the last inspection and associated corrective actions are complete. When equipment and labor covered by the Contractor's warranty, or by a manufacturer's warranty, have been replaced or restored because of its failure during the warranty period, the warranty period for the replaced or repaired equipment or restored work shall be reinstated for a period equal to the original warranty period, and commencing with the date of completion of the replacement or restoration work. In the event any manufacturer customarily provides a warranty period greater than one (1) year, the Contractor's warranty shall be for the same duration for that component.

#### **1.21 SINGULAR NUMBER**

- A. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

## **PART 2 – PRODUCTS**

### **2.01 EQUIPMENT AND MATERIALS**

- A. All equipment associated within the Security Control Room, Security Console and Security Equipment Room shall be UL 827, UL 1981, and UL 60950 compliant and rated for continuous operation. Environmental conditions (i.e. temperature, humidity, wind, and seismic activity) shall be taken under consideration at each facility and site location prior to installation of the equipment.
- B. All equipment shall operate on a 120 or 240 volts alternating current (VAC); 50 Hz or 60 Hz AC power system unless documented otherwise in subsequent sections listed within this specification. All equipment shall have a back-up source of power that will provide a minimum of [8] hours of run time in the event of a loss of primary power to the facility.
- C. The system shall be designed, installed, and programmed in a manner that will allow for ease of operation, programming, servicing, maintenance, testing, and upgrading of the system.
- D. All equipment and materials for the system will be compatible to ensure correct operation.

### **2.02 EQUIPMENT ITEMS**

- A. The Security Management System shall provide full interface with all components of the security subsystem as follows:
  - 1. Shall allow for communication between the Physical Access Control System and Database Management and all subordinate work and monitoring stations, enrollment centers for badging and biometric devices as part of the PACS, local annunciation centers, the electronic Security Management System (SMS), and all other VA redundant or backup command center or other workstations locations.
  - 2. Shall provide automatic continuous communication with all systems that are monitored by the SMS, and shall automatically annunciate any communication failures or system alarms to the SMS operator providing identification of the system, nature of the alarm, and location of the alarm.
  - 3. Controlling devices shall be utilized to interface the SMS with all field devices.
  - 4. The Security control room and security console will be supported by an uninterrupted power supply (UPS) or dedicated backup generator power circuit.
  - 5. The Security Equipment room, Security Control Room, and Security Operator Console shall house the following equipment i.e. refer to individual master specifications for each security subsystem's specific requirements:
    - a. Security Console Bays and Equipment Racks
    - b. Security Network Server and Workstation
    - c. CCTV Monitoring, Controlling, and Recording Equipment
    - d. PACS Monitoring and Controlling Equipment
    - e. IDS Monitoring and Controlling Equipment
    - f. Security Access Detection Monitoring Equipment
    - g. EPPS Monitoring and Controlling Equipment
    - h. Main Panels for all Security Systems
    - i. Power Supply Units (PSU) for all field devices
    - j. Life safety and power monitoring equipment
    - k. All other building systems deemed necessary by the VA to include, but not limited to, heating, ventilation and air conditioning (HVAC), elevator control, portable radio, fire alarm monitoring, and other potential systems.
    - l. Police two-way radio control consoles/units.
- B. Security Console Bays - shall be EIA 310D compliant and:
  - 1. Utilize stand-up, sit-down, and vertical equipment racks in any combination to monitor and control the security subsystems.



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2. Shall be wide enough for equipment that requires a minimum 19 inch (47.5 cm) mounting area.
3. Shall be made of metal, furnished with wire ways, a power strip, a thermostatic controlled bottom or top mounted fan units, a hinge mounted rear door, a hinge mounted front door made of Plexiglas, and a louvered top. When possible, pre-fabricated (standard off-the-shelf) security console equipment shall be used in place of customized designed consoles.
4. A wire management system shall be designed and installed so that all cables are mounted in a manner that they do not interfere with day-to-day operations, are labeled for quick identification, and so that high voltage power cables do not cause signal interference with low voltage and data carrying cables.
5. Shall be mounted on lockable casters.
6. Shall be ergonomically designed so that all devices requiring repetitive interaction with by the operator can be easily accessed, observed, and accomplished.
7. Controls and displays shall be located so that they are not obscured during normal operation. Control and display units installed with a work bench shall be a minimum of 3 in. (7.5 cm) from all edges of the work bench area.
8. All security subsystem controls shall be installed within the same operating console bay of their associated equipment.
9. Video monitors shall be mounted above all controls within a console bay and positioned in a manner that minimum strain is placed on the operator viewing them at the console.
10. At least one workbench for every three (3) console bays shall be provided free of control equipment to allow for appropriate operator workspace.
11. All console devices shall be labeled and marked with a minimum of quarter inch bold print.
12. All non-security related equipment that is required to be monitored shall be installed in a console bay separate from the security subsystem equipment and clearly be identified as such.
13. Console bays and related equipment shall be arranged in priority order and sequenced based upon their pre-defined security subsystem operations criticality established by the Contracting Officer.
14. The following minimum console technical characteristics shall be taken into consideration when designing for and installing the security console and equipment racks:

	Stand-Up	Sit-Down	Vertical Equipment Rack
Workstation Height	No Greater than 84 in. (210 cm)	No greater than 72 in. (150 cm)	No greater than 96 in. (240 cm)
Bench board Slope	21 in. (52.5 cm)	25 in. (62.5 cm)	N/A
Bench board Angle	15 degrees	15 degrees	N/A
Depth of Console	24 in. (60 cm)	24 in. (60 cm)	N/A
Leg and Feet Clearance	6 sq. ft. from center of Console Slope front	6 sq. ft. from center of Console Slope front	6 sq. ft. from center of Console Slope front
Distance Between Console Rows	96 in. (240 cm)	96 in. (240 cm)	96 in. (240 cm)
Distance Between Console and Wall	36 in. (90 cm) from the rear and/or side of console or rack	36 in. (90 cm) from the rear and/or side of console or rack	36 in. (90 cm) from the rear and/or side of console or rack

C. Security Console Configuration:

1. The size shall be defined by the number of console bays required to house and operate the security subsystems, as well as any other factors that may influence the overall design

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- of the space. A small Access Control System and Database Management shall contain no more than four (4) security console bays. A large Access Control System and Database Management shall contain no less than five (5) and no more than eight (8) security console bays.
2. Shall meet the following minimum spacing requirements to ensure that a Access Control System and Database Management is provided to house existing and future security subsystems and other equipment listed in paragraph 2.3.C:
    - a. 500 square feet for a large Access Control System and Database Management.
    - b. 300 square feet for a small Access Control System and Database Management.
    - c. If office, training room and conference space, is a processing area as well as holding cell space is to be located adjacent to the Access Control System and Database Management, these space requirements also need to be considered.
  3. Shall be located in an area within, at a minimum, the first level/line of security defense defined by the VA. If the Access Control System and Database Management is to be located outside the first level of security, then the area shall be constructed or retrofit to meet or exceed those requirements outlined in associated VA Master Specifications.
  4. Shall not be located within or near an area with little to no blast mitigation standoff space protection, adjacent to an outside wall exposed to vehicle parking and traffic, within a basement or potential flood zone area, in close approximately to major utility areas, or near an exposed air intake(s).
  5. Access shall meet UFAS and ADA accessibility requirements.
  6. Construction shall be slab to slab and free of windows, with the exception of a service window. All penetrations into the room shall be sealed with fire stopping materials. This material shall apply in accordance with Section 07 84 00, FIRESTOPPING.
  7. A service window shall be installed in the wall next to the main entrance of the Access Control System and Database Management or where it best can be monitored and accessed by the security console operator. The window shall meet all requirements set forth in UL 752, to include at a minimum, Class III ballistic level protection. The windows shall be set in a minimum of four (4) inches (100 mm) solid concrete units to ceiling height with either masonry or gypsum wall board to the underside of the slab above. It shall also contain a service tray constructed in a manner that only objects no larger than 3 inches (7.5 cm) in width may pass through it.
  8. The walls making up or surrounding the Access Control System and Database Management shall be made of materials that at a minimum offer Class III ballistic level protection for the security console operator(s).
  9. There will be a main power cut-off button/switch located inside the Access Control System and Database Management in the event of an electrical fire or related event occurs.
  10. Shall have a fire alarm detection unit that is tied into the main building fire alarm system and have at least two fire extinguishers located within it.
  11. Shall utilize a fire suppression system similar to that used by the VA's computer and telecommunications room operating areas.
  12. The floor shall be raised a minimum of 4 inches (10 cm) from the concrete floor base. Wire ways shall be utilized under the raised floor for separation of signal and power wires and cables.
  13. Access shall be monitored and controlled by the PACS via card reader and fixed camera that utilizes a wide angle lens. A 1 in. (2.5 cm) deadbolt shall be utilized as a mechanical override for the door in the event of electrical failure of the PACS, card reader, or locking mechanism.
  14. There shall only be one point of ingress and egress to and from the Security Control Room. The door shall be made of solid core wood or better. If a window is required for the door, then the window shall be ballistic resistant with a Millar covering.
  15. A two-way intercom shall be placed at the point of entry into the Security Control Room for access-communication control purposes.

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16. A remote push-button door unlocking device shall not be installed for the electronic PACS locking mechanism providing access control into the Security Control Room.
17. All controlling equipment and power supplies that must be wall mounted shall be mounted in a manner that maximizes usability of the Security Control Room wall space. All equipment shall be mounted to three quarter inch fire retardant plywood. The plywood shall be fastened to the wall from slab to slab and fixed to the existing walls supports.

D. Security Control Room Ventilation

1. Shall meet or exceed all requirements laid out in VA Master Specification listed in Division 23, HEATING, VENTILATION, AND AIR CONDITIONING.
2. Controls shall be via a separate air handling system that provides an isolated supply and return system. The Security Control Room shall have a dedicated thermostat control unit and cut-off switch to be able to shut off ventilation to the control room in the event of a chemical, biological, or radiological (CBR) event or other related emergency.
3. There shall be a louver installed in the control room door to assist with ventilation of the room. The louver shall be exactly 12 x 12 inches (30 x 30 cm) and closeable.

E. Security Control Room and Security Console Lighting:

1. The following factors shall be taken into consideration for lighting of the Security Control Room and console area:
  - a. Shadows: To reduce eye strain and fatigue, shadows shall be avoided.
  - b. Glare: The readability of all display panels, labels, and equipment shall not be interfered with or create visibility problems.
2. The following table shall provide guidance on the amount of footcandles required per work area and type of task performed:

Work Area/Type of Task		Footcandles
Main Operating Panels		50
Secondary Display Panels		50
Seated Workstations		100
Reading	Handwriting	100
	Typed Documents	50
	Visual Display Units	10
Logbook Recording		100
Maintenance Area		50
Emergency/Back-up Lighting		10

F. Remote security console access: For facilities that have a remote, secondary back-up control console or workstation shall apply the following requirements:

1. The secondary stations shall the requirements outlined in Sections 2.2.A-G.
2. Installation of an intercom station or telephone line shall be installed and provide direct one touch call-up for communications between the primary Security Control Console and secondary Security Control Console.
3. Secondary stations shall not have priority over a primary Security Control Console.
4. The primary Access Control System and Database Management shall have the ability to shut off power and a signal to a secondary control station in the event the area has been compromised.

G. Wires and Cables:

1. Shall meet or exceed the manufactures recommendation for power and signals.
2. Shall be carried in an enclosed conduit system, utilizing electromagnetic tubing (EMT) to include the equivalent in flexible metal, rigid galvanized steel (RGS) to include the equivalent of liquid tight, polyvinylchloride (PVC) schedule 40 or 80.
3. All conduits will be sized and installed per the NEC. All security system signal and power cables that traverse or originate in a high security office space will contained in either EMT

- or RGS conduit.
4. All conduit, pull boxes, and junction boxes shall be marked with colored permanent tape or paint that will allow it to be distinguished from all other infrastructure conduit.
  5. Conduit fills shall not exceed 50 percent unless otherwise documented.
  6. A pull string shall be pulled along and provided with signal and power cables to assist in future installations.
  7. At all locations where there is a wall penetration or core drilling is conducted to allow for conduit to be installed, fire stopping materials shall be applied to that area.
  8. High voltage and signal cables shall not share the same conduit and shall be kept separate up to the point of connection. High voltage for the security subsystems shall be any cable or sets of cables carrying 30 VDC/VAC or higher.
  9. For all equipment that is carrying digital data between the Security Control Room, Security Equipment Room, Security Console, or at a remote monitoring station, it shall not be less than 20 AWG and stranded copper wire for each conductor. The cable or each individual conductor within the cable shall have a shield that provides 100% coverage. Cables with a single overall shield shall have a tinned copper shield drain wire.

### 2.03 FIBER OPTIC EQUIPMENT

- A. 8 Channel Fiber Optic Transceivers (Video & PTZ Control)
1. The field-located and central-located fiber optic transceivers shall utilize wave division multiplexing to transmit and receive video and data pan-tilt-zoom control signals over two standard 62.5/125 multimode fibers.
  2. The units shall be capable of operating over a range of 2 km.
  3. The units shall be NTSC color compatible.
  4. The units shall support data rates up to 64 Kbps.
  5. The units shall be surface or rack mountable.
  6. The units shall be UL listed.
  7. The units shall meet or exceed the following specifications:
    - a. Video
      - 1) Input/Output: 1 volt pk-pk (75 ohms)
      - 2) Input/Output Channels: 8
      - 3) Bandwidth: 10 Hz - 6.5 MHz per channel
      - 4) Differential Gain: <2%
      - 5) Differential Phase: <0.7°
      - 6) Tilt: <1%
      - 7) Signal to Noise Ratio: 60 dB
    - b. Data (Control)
      - 1) Data Channels: 2
      - 2) Data Format: RS-232, RS-422, 2 wire or 4 wire RS-485 with Tri-State Manchester Bi-Phase and Sensornet
      - 3) Data Rate: DC - 100 kbps (NRZ)
      - 4) Bit Error Rate: < 1 in 10<sup>9</sup> @ Maximum Optical Loss Budget
      - 5) Operating Mode: Simplex or Full-Duplex
      - 6) Wavelength: 1310/1550 nm, Multimode or Singlemode
      - 7) Optical Emitter: Laser Diode
      - 8) Number of Fibers: 1
    - c. Connectors
      - 1) Optical: ST
      - 2) Power and Data: Terminal Block with Screw Clamps
      - 3) Video: BNC (Gold Plated Center-Pin)
    - d. Electrical and Mechanical
      - 1) Power: 12 VDC @ 500 mA (stand-alone)
      - 2) Current Protection: Automatic Resettable Solid-State Current Limiters

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- e. Environmental
  - 1) MTBF: > 100,000 hours
  - 2) Operating Temp: -40 to 74 deg C (-40 to 165 deg F)
  - 3) Storage Temp: -40 to 85 deg C (-40 to 185 deg F)
  - 4) Relative Humidity: 0% to 95% (non-condensing)
- B. Fiber Optic Transmitters: The central-located fiber optic transmitters shall utilize wave division multiplexing to transmit video and signals over standard 62.5/125 multimode fibers.
  - 1. The units shall be capable of operating over a range of 4.8 km.
  - 2. The units shall be NTSC color compatible.
  - 3. The units shall support data rates up to 64 Kbps.
  - 4. The units shall be surface or rack mountable.
  - 5. The units shall be UL listed.
  - 6. The units shall meet or exceed the following specifications:
    - a. Video
      - 1) Input: 1 volt pk-pk (75 ohms)
      - 2) Bandwidth: 5H2 - 10 MHZ
      - 3) Differential Gain: <5%
      - 4) Tilt: <1%
      - 5) Signal-Noise: 60db
      - 6) Wavelength: 850nm
      - 7) Number of Fibers: 1
      - 8) Operating Temp: -20 to 70 deg C (-4 to 158 deg F)
      - 9) Connectors:
        - (a) Power: Female plug with screw clamps
        - (b) Video: BNC
        - (c) Optical: ST
      - 10) Power: 12 VDC
- C. Fiber Optic Receivers: The field-located fiber optic receivers shall utilize wave division multiplexing to receive video signals over standard 62.5/125 multimode fiber.
  - 1. The units shall be capable of operating over a range of 4.8 km.
  - 2. The units shall be NTSC color compatible.
  - 3. The units shall support data rates up to 64 Kbps.
  - 4. The units shall be surface or rack mountable.
  - 5. The units shall be UL listed.
  - 6. The units shall meet or exceed the following specifications:
    - a. Video
      - 1) Output: 1 volt pk-pk (75 ohms)
      - 2) Bandwidth: 5H2 - 10 MHZ
      - 3) Differential Gain: <5%
      - 4) Tilt: <1%
      - 5) Signal-Noise: 60dB
      - 6) Wavelength: 850nm
      - 7) Number of Fibers: 1
      - 8) Surface Mount: 106.7 x 88.9 x 25.4 mm (4.2 x 3.5 x 1 in)
      - 9) Operating Temp: -20 to 70 deg C (-4 to 158 deg F)
      - 10) Connectors:
      - 11) Power: Female plug block with screw clamps
      - 12) Video: BNC
      - 13) Optical: ST
      - 14) Power: 12 VAC8 Channel Fiber Optic Transceivers (Video & PTZ Control)
- D. Fiber Optic Sub Rack with Power Supply

1. The Card Cage Rack shall provide high-density racking for fiber-optic modules. The unit shall be designed to mount in standard 483 mm (19 in) instrument racks and to accommodate the equivalent of 15 1-inch modules.
  - a. Specifications
    - 1) Card Orientation: Vertical
    - 2) Construction: Aluminum
    - 3) Current Consumption: 0.99 A
    - 4) Humidity: 95.0 % RH
    - 5) Input Power: 100-240 VAC, 60/50 Hz
    - 6) Mounting: Mounts in standard 483 mm (19 in) rack using four (4) screws (optional wall brackets purchased separately)
    - 7) Number of Outputs: 1.0
    - 8) Number of Slots 15.0
    - 9) Operating Temperature: -40 to +75 deg C (-40.0 to 167.0 deg F)
    - 10) Output Voltage: 13.5 V
    - 11) Output Current 6.0 A
    - 12) Power Dissipation: 28.0 W
    - 13) Power Factor: 48.0
    - 14) Power Supply: (built-in)
    - 15) Rack Units: 3RU
    - 16) Redundant Capability: Yes
    - 17) Weight: 2.43 kg (5.35 lb)
    - 18) Width: 483 mm (19.0 in)

#### **2.04 TRANSIENT VOLTAGE SURGE SUPPRESSION DEVICES (TVSS) AND SURGE SUPPRESSION**

##### **A. Transient Voltage Surge Suppression**

1. All cables and conductors extending beyond building perimeter, except fiber optic cables, which serve as communication, control, or signal lines shall be protected against Transient Voltage surges and have Transient Voltage surge suppression protection (TVSS) UL listed in accordance with Standard 497B installed at each end. Lighting and surge suppression shall be a multi-strike variety and include a fault indicator. Protection shall be furnished at the equipment and additional triple solid state surge protectors rated for the application on each wire line circuit shall be installed within 915 mm (36 in) of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following waveforms:
  - a. A 10-microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
  - b. An 8-microsecond rise time by 20-microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.
  - c. Maximum series current: 2 AMPS. Provide units manufactured by Advanced Protection Technologies, model # TE/FA 10B or TE/FA 20B or approved equivalent.
  - d. Operating Temperature and Humidity: -40 to + 85 deg C (-40 to 185 deg F), and 0 to 95 percent relative humidity, non-condensing.

##### **B. Physical Access Control Systems**

1. Suppressors shall be installed on AC power at the point of service and shall meet the following criteria:
  - a. UL1449 2nd Edition, 2007, listed
  - b. UL1449 S.V.R. of 400 Volts or lower
  - c. Status Indicator Light(s)
  - d. Minimum Surge Current Capacity: 40,000 Amps (8 x 20  $\mu$ sec)
  - e. Maximum Continuous Current: 15 Amps
  - f. MCOV: 125 VAC

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- g. Service Voltage: 110-120 VAC
- 2. Suppressors shall be installed on the Low Voltage circuit at both the point of entrance and exit of the building. Suppressors shall meet the following criteria:
  - a. UL 497B
  - b. Minimum Surge Current Capacity: 2,000 Amps per pair
  - c. Maximum Continuous Current: 5 Amps
  - d. MCOV: 33 Volts
  - e. Service Voltage: 24Volts
- 3. Suppressors shall be installed on the communication circuit between the access controller and card reader at both the entrance and exit of the building. Suppressors shall meet the following criteria:
  - a. Conforms with UL497B standards (where applicable)
  - b. Clamp level for 12 and 24V power: 18VDC / 38VDC
  - c. Clamp level for Data/LED: 6.8VDC
  - d. Service Voltage for Power: 12VDC/24VDC
  - e. Service Voltage for Data/LED: <5VDC
  - f. Clamp level – PoE Access Power: 72V
  - g. Clamp level – PoE Access Data: 7.9V
  - h. Service Voltage – PoE Access: 48VAC – 54VAC
  - i. Service Voltage – PoE Data: <5VDC
- C. Intercom Systems
  - 1. Suppressors shall be installed on the AC power at the point of service and shall meet the following criteria:
    - a. UL 1449 Listed
    - b. UL 1449 S.V.R. of 400 Volts or lower
    - c. Diagnostic Indicator Light(s)
    - d. Integrated ground terminating post (where case/chassis ground exists)
    - e. Minimum Surge Current Capacity of 13,000 Amps (8 x 20  $\mu$ Sec)
  - 2. Suppressors shall be installed on incoming central office lines and shall meet the following criteria:
    - a. UL 497A Listed
    - b. Multi Stage protection design
    - c. Auto-reset current protection not to exceed 2 Amps per pair
    - d. Minimum Surge Current of 500 Amps per pair (8 x 20  $\mu$ Sec)
  - 3. Suppressors shall be installed on all telephone/intercom circuits that enter or leave separate buildings and shall meet the following criteria:
    - a. UL 497A Listed (where applicable)
    - b. UL 497B Listed (horns, strobes, speakers or communication circuits over 300 feet)
    - c. Multi Stage protection design
    - d. Auto-reset over-current protection not to exceed 5 Amps per pair
    - e. Minimum Surge Current of 1000 Amps per pair (8 x 20  $\mu$ Sec)
- D. Intrusion Detection Systems
  - 1. Suppressors shall be installed on AC at the point of service and shall meet the following criteria:
    - a. UL 1449, 2nd Edition 2007, listed
    - b. UL 1449 S.V.R. of 400 Volts or lower
    - c. Status Indicator Lights
    - d. Center screw for terminating Class II transformers
    - e. Minimum Surge Current Capacity of 32,000 Amps (8 x 20  $\mu$ Sec)
  - 2. Suppressors shall be installed on all Telephone Communication Interface circuits and shall meet the following criteria:

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- a. UL 497A Listed
  - b. Multi Stage protection design
  - c. Surge Current Capacity: 9,000 Amps (8x20  $\mu$ Sec)
  - d. Clamp Voltage: 130Vrms
  - e. Auto reset current protection not to exceed 150 milliAmps
3. Suppressors shall be installed on all burglar alarm initiating and signaling loops and addressable circuits which enter or leave separate buildings. The following criteria shall be met:
- a. UL 497B for data communications or annunciation (powered loops)
  - b. Fail-short/fail-safe mode.
  - c. Surge Current Capacity: 9,000 Amps (8x20  $\mu$ Sec)
  - d. Clamp Voltage: 15 Vrms
  - e. Joule Rating: 76 Joules per pair (10x1000  $\mu$ Sec)
  - f. Auto-reset current protection not to exceed 150 milliAmps for UL 497A devices.
- E. Video Surveillance System
1. Protectors shall be installed on coaxial cable systems on points of entry and exit from separate buildings. Suppressors shall be installed at each exterior camera location and include protection for 12 and/or 24 volt power, data signal and motor controls (for Pan, Tilt and Zoom systems). SPDs shall protect all modes herein mentioned and contain all modes in a single unit system. Protection for all systems mentioned above shall be incorporated at the head end equipment. Additionally a minimum 450VA battery back up shall be used to protect the DVR or VCR and monitor. Protectors shall meet the following criteria:
    - a. Head-End Power
      - 1) UL 1778, cUL (Battery Back Up)
      - 2) Minimum Surge Current Capacity: 65,000 Amps (8x20 $\mu$ sec)
      - 3) Minimum of two (2) NEMA 5-15R Receptacles (one (1) AC power only, one (1) with UPS)
      - 4) All modes protected (L-N, L-G, N-G)
      - 5) EMI/RFI Filtering
      - 6) Maximum Continuous Current: 12 Amps
    - b. Camera Power
      - 1) Minimum Surge Current Capacity: 1,000 Amps (8X20 $\mu$ sec); 240 Amps for IP Video/PoE cameras
      - 2) Screw Terminal Connection
      - 3) All protection modes L-G (all Lines)
      - 4) MCOV<40VAC
    - c. Video And Data
      - 1) Surge Current Capacity 1,000 Amps per conductor
      - 2) "BNC" Connection (Coax)
      - 3) Protection modes: L-G (Data), Center Pin-G, Shield-G (Coax)
      - 4) Band Pass 0-2GHz
      - 5) Insertion Loss <0.3dB
- F. Grounding and Surge Suppression
1. The Security Contractor shall provide grounding and surge suppression to stabilize the voltage under normal operating conditions. This is to ensure the operation of over current devices, such as fuses, circuit breakers, and relays, underground-fault conditions.
  2. The Contractor shall engineer, provide, and install proper grounding and surge suppression as required by local jurisdiction and prevailing codes and standards, referenced in this document.
  3. Principal grounding components and features shall include: main grounding buses, grounding, and bonding connections to service equipment.



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4. The Contractor shall provide detail drawings of interconnection with other grounding systems including lightning protection systems.
  5. The Contractor shall provide details of locations and sizes of grounding conductors and grounding buses in electrical, data, and communication equipment rooms and closets.
  6. AC power receptacles are not to be used as a ground reference point.
  7. Any cable that is shielded shall require a ground in accordance with applicable codes, the best practices of the trade, and all manufactures' installation instructions.
- G. 120 VAC Surge Suppression
1. Continuous Current: Unlimited (parallel connection)
  2. Max Surge Current: 13,500 Amps
  3. Protection Modes: L - N, L - G, N - G
  4. Warranty: Ten Year Limited Warranty
  5. Dimension: 73.7 x 41.1 x 52.1 mm (2.90 x 1.62 x 2.05 in)
  6. Weight: 2.88 g (0.18 lbs)
  7. Housing: ABS

## 2.05 INSTALLATION KIT

- A. General:
1. The kit shall be provided that, at a minimum, includes all connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks or wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, conduit, cable duct, and/or cable tray, etc., required to accomplish a neat and secure installation. All wires shall terminate in a spade lug and barrier strip, wire wrap terminal or punch block. Unfinished or unlabeled wire connections shall not be allowed. All unused and partially opened installation kit boxes, coaxial, fiber-optic, and twisted pair cable reels, conduit, cable tray, and/or cable duct bundles, wire rolls, physical installation hardware shall be turned over to the Contracting Officer. The following sections outline the minimum required installation sub-kits to be used:
  2. System Grounding:
    - a. The grounding kit shall include all cable and installation hardware required. All head end equipment and power supplies shall be connected to earth ground via internal building wiring, according to the NEC.
    - b. This includes, but is not limited to:
      - 1) Coaxial Cable Shields
      - 2) Control Cable Shields
      - 3) Data Cable Shields
      - 4) Equipment Racks
      - 5) Equipment Cabinets
      - 6) Conduits
      - 7) Cable Duct blocks
      - 8) Cable Trays
      - 9) Power Panels
      - 10) Grounding
      - 11) Connector Panels
  3. Coaxial Cable: The coaxial cable kit shall include all coaxial connectors, cable tying straps, heat shrink tabbing, hangers, clamps, etc., required to accomplish a neat and secure installation.
  4. Wire and Cable: The wire and cable kit shall include all connectors and terminals, audio spade lugs, barrier straps, punch blocks, wire wrap strips, heat shrink tubing, tie wraps, solder, hangers, clamps, labels etc., required to accomplish a neat and orderly installation.
  5. Conduit, Cable Duct, and Cable Tray: The kit shall include all conduit, duct, trays, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat and secure conduit, cable duct, and/or cable tray installation

- in accordance with the NEC and this document.
6. Equipment Interface: The equipment kit shall include any item or quantity of equipment, cable, mounting hardware and materials needed to interface the systems with the identified sub-system(s) according to the OEM requirements and this document.
  7. Labels: The labeling kit shall include any item or quantity of labels, tools, stencils, and materials needed to label each subsystem according to the OEM requirements, as-installed drawings, and this document.
  8. Documentation: The documentation kit shall include any item or quantity of items, computer discs, as installed drawings, equipment, maintenance, and operation manuals, and OEM materials needed to provide the system documentation as required by this document and explained herein.

### **PART 3 – EXECUTION**

#### **3.01 COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATION**

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electronic safety and security equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.
- F. Equipment location shall be as close as practical to locations shown on the drawings.
- G. Inaccessible Equipment:
  1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
  2. "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

#### **3.02 FIRESTOPPING**

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electronic safety and security installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section 07 84 00 "Firestopping."

#### **3.03 COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of Section 28 08 00 – COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to section 28 08 00 – COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS and related sections for contractor responsibilities for system commissioning.

### **3.04 DEMONSTRATION AND TRAINING**

- A. Training shall be provided in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.
- B. Training shall be provided for the particular equipment or system as required in each associated specification.
- C. A training schedule shall be developed and submitted by the contractor and approved by the Resident Engineer at least 30 days prior to the planned training.
- D. Provide services of manufacturer's technical representative for hours to instruct VA personnel in operation and maintenance of units.
- E. Submit training plans and instructor qualifications in accordance with the requirements of Section 28 08 00 – COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

### **3.05 WORK PERFORMANCE**

- A. Job site safety and worker safety is the responsibility of the contractor.
- B. For work on existing stations, arrange, phase and perform work to assure electronic safety and security service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.
- C. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
- D. Coordinate location of equipment and conduit with other trades to minimize interferences. See the GENERAL CONDITIONS.

### **3.06 SYSTEM PROGRAMMING**

- A. A. General Programming Requirements
  - 1. This following section shall be used by the contractor to identify the anticipated level of effort (LOE) required setup, program, and configure the Electronic Security System (ESS). The contractor shall be responsible for providing all setup, configuration, and programming to include data entry for the Security Management System (SMS) and subsystems [(e.g., video matrix switch, intercoms, digital video recorders, intrusion devices, including integration of subsystems to the SMS (e.g., camera call up, time synchronization, intercoms)]. System programming for existing or new SMS servers shall not be conducted at the project site.
- B. Level of Effort for Programming
  - 1. The Contractor shall perform and complete system programming (including all data entry) at an offsite location using the Contractor's own copy of the SMS software. The Contractor's copy of the SMS software shall be of the Owners current version. Once system programming has been completed, the Contractor shall deliver the data to the Resident Engineer on data entry forms and an approved electronic medium, utilizing data from the contract documents. The completed forms shall be delivered to the Resident Engineer for review and approval at least 90 calendar days prior to the scheduled date the Contractor requires it. The Contractor shall not upload system programming until the Resident Engineer has provided written approval. The Contractor is responsible for backing up the system prior to uploading new programming data. Additional programming requirements are provided as follows:
    - a. Programming for New SMS Server: The contractor shall provide all other system related programming. The contractor will be responsible for uploading personnel information (e.g., ID Cards backgrounds, names, access privileges, personnel photos, access schedules, personnel groupings) along with coordinating with Resident Engineer for device configurations, standards, and groupings. VA shall

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- provide database to support Contractor's data entry tasks. The contractor shall anticipate a weekly coordination meeting and working with Resident Engineer to ensure data uploading is performed without incident of loss of function or data loss.
- b. Programming for Existing SMS Servers: The contractor shall perform all related system programming except for personnel data as noted. The contractor will not be responsible for uploading personnel information (e.g., ID Cards backgrounds, names, access privileges, access schedules, personnel groupings). The contractor shall anticipate a weekly coordination meeting and working alongside of Resident Engineer to ensure data uploading is performed without incident of loss of function or data loss. System programming for SMS servers shall be performed by using the Contractor's own server and software. These servers shall not be connected to existing devices or systems at any time.
2. The Contractor shall identify and request from the Resident Engineer, any additional data needed to provide a complete and operational system as described in the contract documents.
  3. Contractor and Resident Engineer coordination on programming requires a high level of coordination to ensure programming is performed in accordance with VA requirements and programming uploads do not disrupt existing systems functionality. The contractor shall anticipate a minimum a weekly coordination meeting. Contractor shall ensure data uploading is performed without incident of loss of function or data loss. The following Level of Effort Chart is provided to communicate the expected level of effort required by contractors on VA ESS projects. Calculations to determine actual levels of effort shall be confirmed by the contractor before project award.

DESCRIPTION OF TASKS							
DESCRIPTION OF SYSTEMS	DEVELOP SYSTEM LOADING SHEETS	COORDINATION	INITIAL SET-UP CONFIGURATION	GRAPHIC MAPS	SYSTEM PROGRAMMING	FINAL CHECKS	LEVEL OF EFFORT (TYPICAL TASKS)
SMS SETUP & CONFIGURATION	E.G., PROGRAM MONITORING STATIONS, PROGRAMMING NETWORKS, INTERCONNECTIONS BETWEEN CCTV, INTERCOMS, TIME SYNCHRONIZATION	E.G., RETRIEVE IP ADDRESSES, NAMING CONVENTIONS, STANDARD EVENT DESCRIPTIONS, PROGRAMMING TEMPLATES, COORDINATION SPECIAL NEEDS	E.G., LOAD SYSTEM OPERATING SYSTEM AND APPLICATION SOFTWARE, GENERAL SYSTEM CONFIGURATIONS	E.G., DEVELOP NAMING CONVENTIONS, DEVELOP FILE FOLDERS, CONFIRMING ACCURACY OF AUTOCADED FLOOR PLANS, CONVERT FILE INTO JPEG FILE	E.G., PROGRAM MONITORING STATIONS, PROGRAMMING NETWORKS, INTERCONNECTIONS BETWEEN CCTV, TIME SYNCHRONIZATION	E.G., CHECK ALL SYSTEM DIAGNOSTICS (E.G., CLIENTS, PANELS)	LOAD AND SET-UP 4-6 CDS AND CONFIGURE SERVERS (TO CONFIGURE LOADING AND CONFIGURING SOFTWARE ADMINISTRATIVE ACCOUNT, AUDIT LOG, KEYSTROKES, MOUSE CLICKS,

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ELECTRONIC ENTRY CONTROL SYSTEMS	E.G., SETUP OF DEVICE, DOOR GROUPS & SCHEDULES, REX, LOCKS, LINK GRAPHICS	E.G., CONFIRMING DEVICE CONFIGURATIONS, NAMING CONVENTIONS, EVENT DESCRIPTIONS AND NARRATIVES	E.G., ENTER DATA FROM LOADING SHEETS; CONFIGURATION COMPONENTS, LINK EVENTS, CAMERAS, AND GRAPHICS	E.G., SETUP OF DEVICE, DOOR GROUPS & SCHEDULES, REX, LOCKS, LINK GRAPHICS	E.G., PERFORMING ENTRY TESTING TO CONFIRM CORRECT SET-UP AND CONFIGURATION	MULTI-SCREEN CONFIGURATION E.G., CREATING A DOOR, DOOR CONFIGURATION, ADDING REQUEST TO EXIT, DOOR MONITORS AND RELAYS, DOOR TIMERS, DOOR RELATED EVENTS (E.G., ACCESS, ACCESS DENIED, FORCED OPEN, HELD OPEN), LINKAGES, CONTROLLED AREAS, ADVANCED DOOR MONITORING, TIME ZONES, SEQUENCE OF OPERATIONS
INTRUSION DETECTION SYSTEMS	E.G., ENTER DOOR GROUPS & SCHEDULES, LINK DEVICES -	E.G., CONFIRMING DEVICE CONFIGURATIONS, NAMING	E.G., ENTER DATA FROM LOADING SHEETS;	E.G., ENTER DOOR GROUPS & SCHEDULES, LINK DEVICES -	E.G., WALK TEST, DEVICE POSITION, AND	E.G., SETTING UP MONITORING AND CONTROL

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	<b>REX, LOCK, &amp; GRAPHICS</b>	<b>CONVENTIONS, EVENTS, DESCRIPTION AND NARRATIVES</b>	<b>CONFIGURATION COMPONENTS, LINKS, EVENTS, CAMERAS, AND GRAPHICS</b>	<b>REX, LOCK, &amp; GRAPHICS</b>	<b>MASKING</b>	<b>POINTS (E.G., MOTION SENSORS, GLASSBREAKS, VIBRATION SENSOR, STROBES, SOUNDERS)</b>
<b>CCTV SYSTEMS</b>	<b>E.G., PROGRAMMING CALL-UPS RECORDING</b>	<b>E.G., CONFIRMING DEVICE CONFIGURATIONS, NAMING</b>	<b>E.G., ENTER DATA FROM LOADING SHEETS;</b>	<b>E.G., PROGRAMMING CALL-UPS RECORDING</b>	<b>E.G., CONFIRM AREA OF COVERAGE, CALL-UP PER</b>	<b>CREATING INTRUSION ZONES, CREATING ARM/DISARM PANEL, TIMED SEQUENCES, TIME ZONES, ICON PLACEMENTS ON GRAPHIC MAPS, CLEARANCE LEVELS, EVENTS (E.G., ARMED, DISARMED, ZONE VIOLATION, DEVICE ALARM ACTIVATIONS), LCD READER MESSAGES,</b>

		CONVENTIONS	CAMERA NAMING CONVENTION, SEQUENCES, CONFIGURE COMPONENTS)			EVENT GENERATED AND RECORDING RATES	G RATIOS (E.G., NORMAL, ALARM EVENT) TIMED RECORDING, LINKAGES, MAPS PLACEMENTS, CALL-UPS
INTERCOM SYSTEMS	E.G., PROGRAMMING EVENTS & CALL-UPS	E.G., CONFIRMING DEVICE CONFIGURATIONS, NAMING CONVENTIONS, EVENT DESCRIPTION AND NARRATIVES	E.G., ENTER DATA FROM LOADING SHEETS; CONFIGURE COMPONENTS, LINK EVENTS, CAMERAS, AND GRAPHICS		E.G., PROGRAMMING EVENTS & CALL-UPS	E.G., CONFIRM OPERATION, SMS EVENT GENERATION AND CAMERA CALL-UP	E.G., SETUP LINKAGES, EVENTS FOR ACTIVATIONS, DEVICE TROUBLES, LAND DEVICES ON GRAPHIC MAPS
CONSOLE MONITORING COMPONENTS	N/A	PER MONITOR	PER MONITOR	PER GRAPHIC MAP	N/A	PER MONITOR	N/A
<b>NOTE: PROGRAMMING TASKS ARE SUPPORTED THROUGH THE CONTRACTOR'S DEVELOPMENT OF THE TECHNICAL DATA PACKAGE SUBMITTALS.</b>							

**TABLE 1 CONTRACTOR LEVEL OF EFFORT**

**3.07 TESTING AND ACCEPTANCE**

A. Performance Requirements

1. General:

- a. The Contractor shall perform contract field, performance verification, and endurance testing and make adjustments of the completed security system when permitted. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing. Written notification of planned testing shall be given to the Resident Engineer at least 60 calendar days prior to the test and after the Contractor has received written approval of the specific test procedures.
- b. The COTR shall witness all testing and system adjustments during testing. Written permission shall be obtained from the Resident Engineer before proceeding with the next phase of testing. Original copies of all data produced during performance verification and endurance testing shall be turned over to the Resident Engineer at

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- the conclusion of each phase of testing and prior to Resident Engineer approval of the test.
2. Test Procedures and Reports: The test procedures, compliant w/ VA standard test procedures, shall explain in detail, step-by-step actions and expected results demonstrating compliance with the requirements of the specification. The test reports shall be used to document results of the tests. The reports shall be delivered to the Resident Engineer within seven (7) calendar days after completion of each test.
- B. Pre-Delivery Testing
1. The purpose of the pre-delivery test is to establish that a system is suitable for installation. As such, pre-delivery test shall be a mock-up of the system as planned in the contract documents. The Contractor shall assemble the Security Test System at the Contractors local project within 50-miles of the project site, and perform tests to demonstrate the performance of the system complies with the contract requirements in accordance with the approved pre-delivery test procedures. The tests shall take place during regular daytime working hours on weekdays. Model numbers of equipment tested shall be identical to those to be delivered to the site. Original copies of all data produced during pre-delivery testing, including results of each test procedure, shall be documented and delivered to the Resident Engineer at the conclusion of pre-delivery testing and prior to Resident Engineer's approval of the test. The test report shall be arranged so all commands, stimuli, and responses are correlated to allow logical interpretation. For Existing System modifications, the contractor shall provide their own server with loaded applicable software to support PDT.
  2. Test Setup: The pre-delivery test setup shall include the following:
    - a. All console equipment.
      - 1) At least one of each type of data transmission media (DTM) and associated equipment to provide a fully integrated PACS.
      - 2) The number of local processors shall equal the amount required by the site design.
      - 3) Enough sensor simulators to provide alarm signal inputs to the system equal to the number of sensors required by the design. The alarm signals shall be manually or software generated.
      - 4) Contractor to prove to owner all systems are appropriately sized and configured as sized.
      - 5) Integration of VASS, intercom systems, other subsystems.
  3. During the bidding process the contractor shall submit a request for information to the Owner to determine if a pre-delivery test will be required. If a pre-delivery test is not required, the contractor shall provide a written notification that the Pre-delivery Test is not required in their shop drawings submission.
- C. Intermediate Testing
1. After completion of 30-50 percent of the installation of ESS cabinet(s) and equipment, one local and remote control stations and prior to any further work, this portion of the system must be pretested, inspected, and certified. Each item of installed equipment shall be checked to ensure appropriate FCC listing & UL certification labels are affixed, NFPA, Emergency, Safety, and JCAHCO guidelines are followed, and proper installation practices are followed. The intermediate test shall include a full operational test.
- D. The inspection and test will be conducted by a factory-certified contractor representative and witnessed by a Government Representative. The results of the inspection will be officially recorded by a designated Government Representative and maintained on file by the Resident Engineer (RE), until completion of the entire project. The results will be compared to the Acceptance Test results.
- E. Contractor's Field Testing (CFT)
1. The Contractor shall calibrate and test all equipment, verify DTM operation, place the integrated system in service, and test the integrated system. Ground rods installed by this



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Contractor within the base of camera poles shall be tested as specified in IEEE STD 142. The Contractor shall test all security systems and equipment, and provide written proof of a 100% operational system before a date is established for the system acceptance test. Documentation package for CFT shall include completed (fully annotated details of test details) for each device and system tested, and annotated loading sheets documenting complete testing to Resident Engineer approval. CFT test documentation package shall conform to submittal requirements outlined in this Section. The Contractor's field testing procedures shall be identical to the Resident Engineer's acceptance testing procedures. The Contractor shall provide the Resident Engineer with a written listing of all equipment and software indicating all equipment and components have been tested and passed. The Contractor shall deliver a written report to the Resident Engineer stating the installed complete system has been calibrated, tested, and is ready to begin performance verification testing; describing the results of the functional tests, diagnostics, and calibrations; and the report shall also include a copy of the approved acceptance test procedure. Performance verification testing shall not take place until written notice by contractor is received certifying that a contractors field test was successful.

F. Performance Verification Test (PVT)

1. Test team:
  - a. After the system has been pretested and the Contractor has submitted the pretest results and certification to the Resident Engineer, then the Contractor shall schedule an acceptance test to date and give the Resident Engineer written, notice as described herein, prior to the date the acceptance test is expected to begin. The system shall be tested in the presence of a Government Representative, an OEM certified representative, representative of the Contractor and other approved by the Resident Engineer. The system shall be tested utilizing the approved test equipment to certify proof of performance, FCC, UL and Emergency Service compliance. The test shall verify that the total system meets all the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.
2. The Contractor shall demonstrate the completed Physical Access Control System PACS complies with the contract requirements. In addition, the Contractor shall provide written certification that the system is 100% operational prior to establishing a date for starting PVT. Using approved test procedures, all physical and functional requirements of the project shall be demonstrated and shown. The PVT will be stopped and aborted as soon as 10 technical deficiencies are found requiring correction. The Contractor shall be responsible for all travel and lodging expenses incurred for out-of-town personnel required to be present for resumption of the PVT. If the acceptance test is aborted, the re-test will commence from the beginning with a retest of components previously tested and accepted.
3. The PVT, as specified, shall not begin until receipt of written certification that the Contractors Field Testing was successful. This shall include certification of successful completion of testing as specified in paragraph "Contractor's Field Testing", and upon successful completion of testing at any time when the system fails to perform as specified. Upon termination of testing by the Resident Engineer or Contractor, the Contractor shall commence an assessment period as described for Endurance Testing Phase II.
4. Upon successful completion of the acceptance test, the Contractor shall deliver test reports and other documentation, as specified, to the Resident Engineer prior to commencing the endurance test.
5. Additional Components of the PVT shall include:
  - a. System Inventory
    - 1) All Device equipment
    - 2) All Software
    - 3) All Logon and Passwords
    - 4) All Cabling System Matrices

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- 5) All Cable Testing Documents
  - 6) All System and Cabinet Keys
  - b. Inspection
    - 1) Contractor shall record an inspection punch list noting all system deficiencies. The contractor shall prepare an inspection punch list format for Resident Engineers approval.
    - 2) As a minimum the punch list shall include a listing of punch list items, punch list item location, description of item problem, date noted, date corrected, and details of how item was corrected.
  6. Partial PVT - At the discretion of Resident engineer, the Performance Verification Test may be performed in part should a 100% compliant CFT be performed. In the event that a partial PVT will be performed instead of a complete PVT; the partial PVT shall be performed by testing 10% of the system. The contractor shall perform a test of each procedure on select devices or equipment.
- G. Endurance Test
1. The Contractor shall demonstrate the specified probability of detection and false alarm rate requirements of the completed system. The endurance test shall be conducted in phases as specified below. The endurance test shall not be started until the Resident Engineer notifies the Contractor, in writing, that the performance verification test is satisfactorily completed, training as specified has been completed, and correction of all outstanding deficiencies has been satisfactorily completed. VA shall operate the system 24 hours per day, including weekends and holidays, during Phase I and Phase III endurance testing. VA will maintain a log of all system deficiencies. The Resident Engineer may terminate testing at any time the system fails to perform as specified. Upon termination of testing, the Contractor shall commence an assessment period as described for Phase II. During the last day of the test, the Contractor shall verify the appropriate operation of the system. Upon successful completion of the endurance test, the Contractor shall deliver test reports and other documentation as specified to the Resident Engineer prior to acceptance of the system.
  2. Phase I (Testing): The test shall be conducted 24 hours per day for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized in writing by the Resident Engineer. If the system experiences no failures, the Contractor may proceed directly to Phase III testing after receiving written permission from the Resident Engineer.
  3. Phase II (Assessment):
    - a. After the conclusion of Phase I, the Contractor shall identify all failures, determine causes of all failures, repair all failures, and deliver a written report to the Resident Engineer. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and recommend the point at which testing should be resumed.
    - b. After delivering the written report, the Contractor shall convene a test review meeting at the job site to present the results and recommendations to the Resident Engineer. The meeting shall not be scheduled earlier than five (5) business days after the Resident Engineer receives the report. As part of this test review meeting, the Contractor shall demonstrate all failures have been corrected by performing appropriate portions of the performance verification test. Based on the Contractor's report and the test review meeting, the Resident Engineer will provide a written determine of either the restart date or require Phase I be repeated.
  4. Phase III (Testing): The test shall be conducted 24 hours per day for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized in writing by the COTR.
  5. Phase IV (Assessment):

- a. After the conclusion of Phase III, the Contractor shall identify all failures, determine causes of all failures, repair all failures, and deliver a written report to the COTR. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and recommend the point at which testing should be resumed.
- b. After delivering the written report, the Contractor shall convene a test review meeting at the job site to present the results and recommendations to the COTR. The meeting shall not be scheduled earlier than five (5) business days after receipt of the report by the COTR. As a part of this test review meeting, the Contractor shall demonstrate that all failures have been corrected by repeating appropriate portions for the performance verification test. Based on the review meeting the test should not be scheduled earlier than five (5) business days after the Resident Engineer receives the report. As a part of this test review meeting, the Contractor shall demonstrate all failures have been corrected by repeating appropriate portions of the performance verification test. Based on the Contractor's report and the test review meeting, the Resident Engineer will provide a written determine of either the restart date or require Phase III be repeated. After the conclusion of any re-testing which the Resident Engineer may require, the Phase IV assessment shall be repeated as if Phase III had just been completed.

H. Exclusions

1. The Contractor will not be held responsible for failures in system performance resulting from the following:
  - a. An outage of the main power in excess of the capability of any backup power source provided the automatic initiation of all backup sources was accomplished and that automatic shutdown and restart of the PACS performed as specified.
  - b. Failure of an Owner furnished equipment or communications link, provided the failure was not due to Contractor furnished equipment, installation, or software.
  - c. Failure of existing Owner owned equipment, provided the failure was not due to Contractor furnished equipment, installation, or software.

**END OF SECTION**

**SECTION 280513**  
**CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY**

**PART 1 - GENERAL**

**1.01 DESCRIPTION**

- A. This section specifies the finishing, installation, connection, testing and certification the conductors and cables required for a fully functional for electronic safety and security (ESS) system.

**1.02 RELATED WORK**

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- B. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping application and use.
- C. Section 28 05 00 – COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. Requirements for general requirements that are common to more than one section in Division 28.
- D. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- E. Section 28 05 28.33 - CONDUITS AND BOXES FOR ELECTRONIC SECURITY AND SAFETY. Requirements for infrastructure.
- F. Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS. Requirements for commissioning.
- G. Section 31 20 00 - EARTH MOVING. For excavation and backfill for cables that are installed in conduit.

**1.03 DEFINITIONS**

- A. BICSI: Building Industry Consulting Service International.
- B. EMI: Electromagnetic interference.
- C. IDC: Insulation displacement connector.
- D. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- E. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- F. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).
- G. RCDD: Registered Communications Distribution Designer.
- H. Solid-Bottom or Non-ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.
- I. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.
- J. UTP: Unshielded twisted pair.

**1.04 QUALITY ASSURANCE**

- A. See section 28 05 00, Paragraph 1.4.

**1.05 SUBMITTALS**

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:

1. Manufacturer's Literature and Data: Showing each cable type and rating.
2. Certificates: Two weeks prior to final inspection, deliver to the Resident Engineer/COTR four copies of the certification that the material is in accordance with the drawings and specifications and diagrams for cable management system.
3. Shop Drawings: Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
  - a. Vertical and horizontal offsets and transitions.
  - b. Clearances for access above and to side of cable trays.
  - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
  - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
  - e. System labeling schedules, including electronic copy of labeling schedules that are part of the cable and asset identification system of the software specified in Parts 2 and 3.
4. Wiring Diagrams. Show typical wiring schematics including the following:
  - a. Workstation outlets, jacks, and jack assemblies.
  - b. Patch cords.
  - c. Patch panels.
5. Cable Administration Drawings: As specified in Part 3 "Identification" Article.
6. Project planning documents as specified in Part 3.
7. Maintenance Data: For wire and cable to include in maintenance manuals.

#### **1.06 APPLICABLE PUBLICATIONS**

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by the basic designation only.
- B. American Society of Testing Material (ASTM):
  1. D2301-04 - Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape
- C. Federal Specifications (Fed. Spec.):
  1. A-A-59544-08 - Cable and Wire, Electrical (Power, Fixed Installation)
- D. National Fire Protection Association (NFPA):
  1. 70-11 - National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
  1. 44-05 - Thermoset-Insulated Wires and Cables
  2. 83-08 - Thermoplastic-Insulated Wires and Cables
  3. 467-07 - Electrical Grounding and Bonding Equipment
  4. 486A-03 - Wire Connectors and Soldering Lugs for Use with Copper Conductors
  5. 486C-04 - Splicing Wire Connectors
  6. 486D-05 - Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations
  7. 486E-00 - Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
  8. 493-07 - Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable
  9. 514B-04 - Fittings for Cable and Conduit
  10. 1479-03 - Fire Tests of Through-Penetration Fire Stops

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Test cables upon receipt at Project site.
  1. Test optical fiber cable to determine the continuity of the strand end to end. Use [optical-fiber flashlight] [or] [optical loss test set] .

2. Test optical fiber cable on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; include the loss value of each. Retain test data and include the record in maintenance data.
3. Test each pair of UTP cable for open and short circuits.

### 1.08 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install UTP, optical fiber, and coaxial cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

## PART 2 - PRODUCTS

### 2.01 GENERAL

General: All cabling locations shall be in conduit systems as outlined in Division 28 unless a waiver is granted in writing or an exception is noted on the construction drawings.//

- A. Support of Open Cabling: NRTL labeled for support of [Category 5e] [Category 6] cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
  1. Support brackets with cable tie slots for fastening cable ties to brackets.
  2. Lacing bars and spools.
  3. Straps and other devices.
- B. Cable Trays:
  1. Cable Tray Materials: Metal, suitable for indoors, and protected against corrosion by [electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inch (0.012 mm) thick] [hot-dip galvanizing, complying with ASTM A 123/A 123M Grade 0.55, not less than 0.002165 inch (0.055 mm) thick].
  2. Basket Cable Trays: [6 inches (150 mm) wide and 2 inches (50 mm) deep] . Wire mesh spacing shall not exceed 2 by 4 inches (50 by 100 mm).
  3. Trough Cable Trays: [Nominally 6 inches (150 mm)] wide.
  4. Ladder Cable Trays: [Nominally 18 inches (455 mm)] wide, and a rung spacing of [12 inches (305 mm)] .
  5. Channel Cable Trays: One-piece construction, [nominally 4 inches (100 mm)] wide. Slot spacing shall not exceed 4-1/2 inches (115 mm) o.c.
  6. Solid-Bottom Cable Trays: One-piece construction, [nominally 12 inches (305 mm)] wide. Provide [with] [without] solid covers.
- C. Conduit and Boxes: Comply with requirements in Division 28 Section "Conduits and Backboxes for Electrical Systems." [Flexible metal conduit shall not be used.]
  1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

### 2.02 BACKBOARDS

- A. Backboards: Plywood, [fire-retardant treated,] 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels in Division 06 Section "Rough Carpentry".

### 2.03 UTP CABLE

- A. Description: 100-ohm, 4-pair UTP, formed into 25-pair binder groups covered with a blue thermoplastic jacket.
  1. Comply with ICEA S-90-661 for mechanical properties.
  2. Comply with TIA/EIA-568-B.1 for performance specifications.
  3. Comply with TIA/EIA-568-B.2, Category 6.

4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
  - a. Communications, General Purpose: Type CM or CMG [; or MPP, CMP, MPR, CMR, MP, or MPG].
  - b. Communications, Plenum Rated: Type CMP [; or MPP], complying with NFPA 262.
  - c. Communications, Riser Rated: Type CMR [; or MPP, CMP, or MPR], complying with UL 1666.
  - d. Communications, Limited Purpose: Type CMX[; or MPP, CMP, MPR, CMR, MP, MPG, CM, or CMG].

#### **2.04 UTP CABLE HARDWARE**

- A. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.
- B. Connecting Blocks: 110-style for Category 6. Provide blocks for the number of cables terminated on the block, plus [25] percent spare. Integral with connector bodies, including plugs and jacks where indicated.

#### **2.05 OPTICAL FIBER CABLE**

- A. Description: Multimode, [50/125] [62.5/125]-micrometer, [24] -fiber, [nonconductive,] tight buffer, optical fiber cable.
  1. Comply with ICEA S-83-596 for mechanical properties.
  2. Comply with TIA/EIA-568-B.3 for performance specifications.
  3. Comply with [TIA/EIA-492AAAA-B] [TIA/EIA-492AAAA-A] for detailed specifications.
  4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
    - a. General Purpose, Nonconductive: Type OFN or OFNG [, or OFNR, OFNP].
    - b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
    - c. Riser Rated, Nonconductive: Type OFNR [or OFNP], complying with UL 1666.
    - d. General Purpose, Conductive: Type OFC or OFCG [; or OFNG, OFN, OFCR, OFNR, OFCP, or OFNP].
    - e. Plenum Rated, Conductive: Type OFCP [ or OFNP], complying with NFPA 262.
    - f. Riser Rated, Conductive: Type OFCR [; or OFNR, OFCP, or OFNP], complying with UL 1666.
  5. Conductive cable shall be [steel] [aluminum] armored type.
  6. Maximum Attenuation: [3.50] dB/km at 850 nm; [1.5] dB/km at 1300 nm.
  7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
- B. Jacket:
  1. Jacket Color: [Aqua for 50/125-micrometer cable] [Orange for 62.5/125-micrometer cable].
  2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
  3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

#### **2.06 OPTICAL FIBER CABLE HARDWARE**

- A. Cable Connecting Hardware: Meet the Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
  1. Quick-connect, simplex and duplex, [Type SC] [Type ST] [Type LC] [Type MT-RJ] connectors. Insertion loss shall be not more than 0.75 dB.
  2. Type SFF connectors may be used in termination racks, panels, and equipment packages.

## 2.07 COAXIAL CABLE

- A. General Coaxial Cable Requirements: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz.
- B. RG-11/U: NFPA 70, Type CATV.
  - 1. No. [14] AWG, solid, copper-covered steel conductor.
  - 2. Gas-injected, foam-PE insulation.
  - 3. Double shielded with 100 percent aluminum polyester tape and 60 percent aluminum braid.
  - 4. Jacketed with sunlight-resistant, black PVC or PE.
  - 5. Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C.
- C. RG-6/U: NFPA 70, Type CATV or CM.
  - 1. No. [16] AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
  - 2. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
  - 3. Jacketed with black PVC or PE.
  - 4. Suitable for indoor installations.
- D. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655, and with NFPA 70 "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:
  - 1. CATV Cable: Type CATV[, or CATVP or CATVR].
  - 2. CATV Plenum Rated: Type CATVP, complying with NFPA 262.
  - 3. CATV Riser Rated: Type CATVR or CATVP, CATVR, or CATV, complying with UL 1666.
  - 4. CATV Limited Rating: Type CATVX.

## 2.08 COAXIAL CABLE HARDWARE

- A. Coaxial-Cable Connectors: Type BNC, 75 ohms.

## 2.09 RS-232 CABLE

- A. Standard Cable: NFPA 70, Type CM.
  - 1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
  - 2. Polypropylene insulation.
  - 3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
  - 4. PVC jacket.
  - 5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
  - 6. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated Cable: NFPA 70, Type CMP.
  - 1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
  - 2. Plastic insulation.
  - 3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
  - 4. Plastic jacket.
  - 5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
  - 6. Flame Resistance: Comply with NFPA 262.

## 2.10 RS-485 CABLE

- A. Standard Cable: NFPA 70, Type CM[ or CMG].
  - 1. Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.
  - 2. PVC insulation.



3. Unshielded.
  4. PVC jacket.
  5. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated Cable: NFPA 70, Type CMP.
1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
  2. Fluorinated ethylene propylene insulation.
  3. Unshielded.
  4. Fluorinated ethylene propylene jacket.
  5. Flame Resistance: NFPA 262, Flame Test.

## **2.11 LOW-VOLTAGE CONTROL CABLE**

- A. Paired Lock Cable: NFPA 70, Type CMG.
1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
  2. PVC insulation.
  3. Unshielded.
  4. PVC jacket.
  5. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.
1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
  2. PVC insulation.
  3. Unshielded.
  4. PVC jacket.
  5. Flame Resistance: Comply with NFPA 262.
- C. Paired Lock Cable: NFPA 70, Type CMG.
1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
  2. PVC insulation.
  3. Unshielded.
  4. PVC jacket.
  5. Flame Resistance: Comply with UL 1581.
- D. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.
1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
  2. Fluorinated ethylene propylene insulation.
  3. Unshielded.
  4. Plastic jacket.
  5. Flame Resistance: NFPA 262, Flame Test.

## **2.12 CONTROL-CIRCUIT CONDUCTORS**

- A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway complying with UL 83.
- B. Class 2 Control Circuits: Stranded copper, [Type THHN-THWN, in raceway] [power-limited cable, concealed in building finishes] [power-limited tray cable, in cable tray] complying with UL 83.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF, complying with UL 83.

## **2.13 FIRE ALARM WIRE AND CABLE**

- A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- B. Signaling Line Circuits: Twisted, shielded pair, [not less than] [No. 18 AWG] [AWG] [size as recommended by system manufacturer].

1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a 2-hour rating.
- C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
  1. Low-Voltage Circuits: No. 16 AWG, minimum.
  2. Line-Voltage Circuits: No. 12 AWG, minimum.
  3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor[ with outer jacket] with red identifier stripe, NRTL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

#### **2.14 IDENTIFICATION PRODUCTS**

- A. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

#### **2.15 SOURCE QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.
- E. Factory sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- F. Cable will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

#### **2.16 WIRE LUBRICATING COMPOUND**

- A. Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.
- B. Shall not be used on wire for isolated type electrical power systems.

#### **2.17 FIREPROOFING TAPE**

- A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.
- B. The tape shall be self-extinguishing and shall not support combustion. It shall be arc-proof and fireproof.
- C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus and be resistant to sunlight and ultraviolet light.
- D. The finished application shall withstand a 200-ampere arc for not less than 30 seconds.
- E. Securing tape: Glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (3/4 inch) wide.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION OF CONDUCTORS AND CABLES**

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
  1. Comply with TIA/EIA-568-B.1.
  2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."

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3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Terminate all conductors; no cable shall contain un-terminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
9. Pulling Cable:
  - a. Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
  - b. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
  - c. Use ropes made of nonmetallic material for pulling feeders.
  - d. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the Resident Engineer/COTR.
  - e. Pull in multiple cables together in a single conduit.
- C. Splice cables and wires where necessary only in outlet boxes, junction boxes, or pull boxes.
  1. Splices and terminations shall be mechanically and electrically secure.
  2. Where the Government determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices at no additional cost to the Government.
- D. Seal cable and wire entering a building from underground, between the wire and conduit where the cable exits the conduit, with a non-hardening approved compound.
- E. Unless otherwise specified in other sections install wiring and connect to equipment/devices to perform the required functions as shown and specified.
- F. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.
- G. Where separate power supply circuits are not shown, connect the systems to the nearest panel boards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.
- H. Install a red warning indicator on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.
- I. System voltages shall be 120 volts or lower where shown on the drawings or as required by the NEC.
- J. UTP Cable Installation:
  1. Comply with TIA/EIA-568-B.2.
  2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
- K. Optical Fiber Cable Installation:
  1. Comply with TIA/EIA-568-B.3.
  2. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.
- L. Open-Cable Installation:
  1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than [60 inches (1525 mm)] apart.
  3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- M. Installation of Cable Routed Exposed under Raised Floors:
1. Install plenum-rated cable only.
  2. Install cabling after the flooring system has been installed in raised floor areas.
  3. Coil cable [72 inches (1830 mm)] long shall be neatly coiled not less than [12 inches (300 mm)] in diameter below each feed point.
- N. Outdoor Coaxial Cable Installation:
1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors to keep out moisture.
  2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).
- O. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
  2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).
  3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
  4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
  5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
  6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

### **3.02 FIRE ALARM WIRING INSTALLATION**

- A. Comply with NECA 1 and NFPA 72.
- B. Wiring Method: Install wiring in metal raceway according to Division 28 Section CONDUITS AND BACKBOXES FOR ELECTRICAL SYSTEMS."
1. Install plenum cable in environmental air spaces, including plenum ceilings.
  2. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.
- C. Wiring Method:
1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.

2. Fire-Rated Cables: Use of 2-hour, fire-rated fire alarm cables, NFPA 70, Types MI and CI, is[ not] permitted.
  3. Signaling Line Circuits: Power-limited fire alarm cables [may] [shall not] be installed in the same cable or raceway as signaling line circuits.
- D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- F. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
- G. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.
- H. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

### 3.03 CONTROL CIRCUIT CONDUCTORS

- A. Minimum Conductor Sizes:
1. Class 1 remote-control and signal circuits, No. 14 AWG.
  2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
  3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

### 3.04 CONNECTIONS

- A. Comply with requirements in Division 28 Section, PHYSICAL ACCESS CONTROL for connecting, terminating, and identifying wires and cables.
- B. Comply with requirements in Division 28 Section "INTRUSION DETECTION" for connecting, terminating, and identifying wires and cables.
- C. Comply with requirements in Division 28 Section "VIDEO SURVEILLANCE" for connecting, terminating, and identifying wires and cables.
- D. Comply with requirements in Division 28 Section "ELECTRONIC PERSONAL PROTECTION SYSTEMS" for connecting, terminating, and identifying wires and cables.
- E. Comply with requirements in Division 28 Section "FIRE DETECTION AND ALARM" for connecting, terminating, and identifying wires and cables.

### 3.05 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "PENETRATION FIRESTOPPING."
- B. Comply with TIA/EIA-569-A, "Firestopping" Annex A.
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

### 3.06 GROUNDING

- A. For communications wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

- B. For low-voltage wiring and cabling, comply with requirements in Division 28 Section "GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY."

### 3.07 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A.
- B. Install a permanent wire marker on each wire at each termination.
- C. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- D. Wire markers shall retain their markings after cleaning.
- E. In each handhole, install embossed brass tags to identify the system served and function.

### 3.08 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  - 1. Visually inspect UTP and optical fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
  - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  - 3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
  - 4. Optical Fiber Cable Tests:
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    - b. Link End-to-End Attenuation Tests:
      - 1) Multimode Link Measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
      - 2) Attenuation test results for links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
  - 5. Coaxial Cable Tests: Comply with requirements in Division 27 Section "Master Antenna Television System."
- D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

**3.09 EXISTING WIRING**

- A. Unless specifically indicated on the plans, existing wiring shall not be reused for the new installation. Only wiring that conforms to the specifications and applicable codes may be reused. If existing wiring does not meet these requirements, existing wiring may not be reused and new wires shall be installed.

**END OF SECTION**

**SECTION 280526**  
**GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY**

**PART 1 - GENERAL**

**1.01 DESCRIPTION**

- A. This section specifies the finishing, installation, connection, testing and certification of the grounding and bonding required for a fully functional Electronic Safety and Security (ESS) system.
- B. "Grounding electrode system" refers to all electrodes required by NEC, as well as including made, supplementary, grounding electrodes.
- C. The terms "connect" and "bond" are used interchangeably in this specification and have the same meaning

**1.02 RELATED WORK**

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- B. Section 28 05 00 - REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS. For general electrical requirements, quality assurance, coordination, and project conditions that are common to more than one section in Division 28.
- C. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for low voltage power and lighting wiring.
- D. Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS. Requirements for commissioning.

**1.03 SUBMITTALS**

- A. Submit in accordance with Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
- B. Shop Drawings:
  - 1. Clearly present enough information to determine compliance with drawings and specifications.
  - 2. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.
- C. Test Reports: Provide certified test reports of ground resistance.
- D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COTR:
  - 1. Certification that the materials and installation are in accordance with the drawings and specifications.
  - 2. Certification by the contractor that the complete installation has been properly installed and tested.

**1.04 APPLICABLE PUBLICATIONS**

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American Society for Testing and Materials (ASTM):
  - 1. B1-07 - Standard Specification for Hard-Drawn Copper Wire
  - 2. B3-07 - Standard Specification for Soft or Annealed Copper Wire
  - 3. B8-04 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
  - 1. 81-1983 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System



2. C2-07 - National Electrical Safety Code
- D. National Fire Protection Association (NFPA):
  1. 70-11 - National Electrical Code (NEC)
  2. 99-2005 - Health Care Facilities
- E. Underwriters Laboratories, Inc. (UL):
  1. 44-05 - Thermoset-Insulated Wires and Cables
  2. 83-08 - Thermoplastic-Insulated Wires and Cables
  3. 467-07 - Grounding and Bonding Equipment
  4. 486A-486B-03 - Wire Connectors

## **PART 2 - PRODUCTS**

### **2.01 GROUNDING AND BONDING CONDUCTORS**

- A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm<sup>2</sup> (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 25 mm<sup>2</sup> (4 AWG) and larger shall be permitted to be identified per NEC.
- B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm<sup>2</sup> (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.

### **2.02 GROUND RODS**

- A. Copper clad steel, 19 mm (3/4-inch) diameter by 3000 mm (10 feet) long, conforming to UL 467.
- B. Quantity of rods shall be as required to obtain the specified ground resistance.

### **2.03 SPLICES AND TERMINATION COMPONENTS**

- A. Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).2.4 ground connections
- B. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- C. Below Grade: Exothermic-welded type connectors.
- D. Above Grade:
  1. Bonding Jumpers: Compression-type connectors, using zinc-plated fasteners and external tooth lockwashers.
  2. Connection to Building Steel: Exothermic-welded type connectors.
  3. Ground Busbars: Two-hole compression type lugs, using tin-plated copper or copper alloy bolts and nuts.
  4. Rack and Cabinet Ground Bars: One-hole compression-type lugs, using zinc-plated or copper alloy fasteners.
  5. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
    - a. a) Pipe Connectors: Clamp type, sized for pipe.
  6. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

### **2.04 EQUIPMENT RACK AND CABINET GROUND BARS**

- A. Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks with minimum dimensions of 4 mm thick by 19 mm wide (3/8 inch x 3/4 inch).

## **2.05 GROUND TERMINAL BLOCKS**

- A. At any equipment mounting location (e.g., backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide screw lug-type terminal blocks.

## **2.06 SPLICE CASE GROUND ACCESSORIES**

- A. Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 16 mm<sup>2</sup> (6 AWG) insulated ground wire with shield bonding connectors.

## **2.07 COMPUTER ROOM GROUND**

- A. Provide 50mm<sup>2</sup> (1/0 AWG) bare copper grounding conductors bolted at mesh intersections to form an equipotential grounding grid. The equipotential grounding grid shall form a 600mm (24 inch) mesh pattern. The grid shall be bonded to each of the access floor pedestals.

## **2.08 SECURITY CONTROL ROOM GROUND**

- A. Provide 50mm<sup>2</sup> (1/0 AWG) stranded copper grounding conductor(s) color coded with a green jacket, bolted at the Room's Communications System Grounding Electrode Cooper Plate and circulate to each equipment rack ground buss bar through the wire management system. Connect each equipment rack, wire management system's cable tray, ladder, etc. to the circulating ground wire with a minimum 25mm<sup>2</sup> (4AWG) stranded Cooper Wire, color coded with a green jacket.
  - 1. Connect each equipment rack ground buss bar to the circulating ground wire as indicated in 2.9.A, and
  - 2. Connect each additional room item to the circulating ground wire as indicated in 2.9.A.

## **PART 3 - EXECUTION**

### **3.01 GENERAL**

- A. Ground in accordance with the NEC, as shown on drawings, and as specified herein.
- B. System Grounding:
  - 1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.
  - 2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.

### **3.02 CORROSION INHIBITORS**

- A. When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

### **3.03 CONDUCTIVE PIPING**

- A. Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

### **3.04 COMPUTER ROOM/SECURITY EQUIPMENT ROOM GROUNDING**

- A. Conduit: Ground and bond metallic conduit systems as follows:
  - 1. Ground metallic service conduit and any pipes entering or being routed within the computer room at each end using 16 mm<sup>2</sup> (6AWG) bonding jumpers.
  - 2. Bond at all intermediate metallic enclosures and across all joints using 16 mm<sup>2</sup> (6 AWG) bonding jumpers.

### **3.05 WIREWAY GROUNDING**

- A. Ground and Bond Metallic Wireway Systems as follows:
  - 1. Bond the metallic structures of wireway to provide 100 percent electrical continuity throughout the wireway system by connecting a 16 mm<sup>2</sup> (6 AWG) bonding jumper at all

intermediate metallic enclosures and across all section junctions.

2. Install insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers between the wireway system bonded as required in paragraph 1 above, and the closest building ground at each end and approximately every 16 meters (50 feet).
3. Use insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and cross all section junctions.
4. Use insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 meters.

### **3.06 LIGHTNING PROTECTION SYSTEM**

- A. Bond the lightning protection system to earth ground externally to the building. Under no condition shall the electrical system's third or fourth ground electrode system, or the telecommunications system circulating ground system be connected to the lightning protection system. The Facility's structural steel may be used to connect the lightning protection system at the direction of the Resident Engineer certified by an independent certified grounding contractor.

### **3.07 EXTERIOR LIGHT/CAMERA POLES**

- A. Provide 20 ft [6.1 M] of No. 4 bare copper coiled at bottom of pole base excavation prior to pour, plus additional unspliced length in and above foundation as required to reach pole ground stud.

### **3.08 GROUND RESISTANCE**

- A. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Government. Final tests shall ensure that this requirement is met.
- B. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not fewer than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.
- C. Services at power company interface points shall comply with the power company ground resistance requirements.
- D. Below-grade connections shall be visually inspected by the //Resident Engineer// //COTR// prior to backfilling. The contractor shall notify the //Resident Engineer// //COTR// 24 hours before the connections are ready for inspection.

### **3.09 GROUND ROD INSTALLATION**

- A. Drive each rod vertically in the earth, not less than 3000 mm (10 feet) in depth.
- B. Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connectors.
- C. Where rock prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified resistance.

### **3.10 GROUNDING FOR RF/EMI CONTROL**

- A. Install bonding jumpers to bond all conduit, cable trays, sleeves and equipment for low voltage signaling and data communications circuits. Bonding jumpers shall consist of 100 mm (4 inches) wide copper strip or two 6 mm<sup>2</sup> (10 AWG) copper conductors spaced minimum 100 mm (4 inches) apart. Use 16 mm<sup>2</sup> (6 AWG) copper where exposed and subject to damage.
- B. Comply with the following when shielded cable is used for data circuits.
  1. Shields shall be continuous throughout each circuit.

2. Connect shield drain wires together at each circuit connection point and insulate from ground. Do not ground the shield.
3. Do not connect shields from different circuits together.
4. Shield shall be connected at one end only. Connect shield to signal reference at the origin of the circuit. Consult with equipment manufacturer to determine signal reference.//

### **3.11 LABELING**

- A. Comply with requirements in Division 26 Section "ELECTRICAL IDENTIFICATION" Article for instruction signs. The label or its text shall be green.
- B. Install labels at the telecommunications bonding conductor and grounding equalizer //and at the grounding electrode conductor where exposed//.
  1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

### **3.12 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Tests and Inspections:
  1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal at individual ground rods. Make tests at ground rods before any conductors are connected.
    - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - b. Perform tests by fall-of-potential method according to IEEE 81.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
  1. Power Distribution Units or Panel boards Serving Electronic Equipment: 3 ohm(s).
  2. Manhole Grounds: 10 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

**END OF SECTION**

**SECTION 280528.33**  
**CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY**

**PART 1 - GENERAL**

**1.01 DESCRIPTION**

- A. This section specifies the finishing, installation, connection, testing certification of the conduit, fittings, and boxes to form a complete, coordinated, raceway system(s). Conduits and when approved separate UL Certified and Listed partitioned telecommunications raceways are required for a fully functional Electronic Safety and Security (ESS) system. Raceways are required for all electronic safety and security cabling unless shown or specified otherwise.
- B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

**1.02 RELATED WORK**

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- B. Section 06 10 00 - ROUGH CARPENTRY. Requirements for mounting board for communication closets.
- C. Section 07 84 00 - FIRESTOPPING. Requirements for sealing around penetrations to maintain the integrity of fire rated construction.
- D. Section 07 60 00 - FLASHING AND SHEET METAL. Requirements for fabrications for the deflection of water away from the building envelope at penetrations.
- E. Section 07 92 00 - JOINT SEALANTS. Requirements for sealing around conduit penetrations through the building envelope to prevent moisture migration into the building.
- F. Section 09 91 00 - PAINTING. Requirements for identification and painting of conduit and other devices.
- G. Section 28 05 00 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. For general electrical requirements, general arrangement of the contract documents, coordination, quality assurance, project conditions, equipment and materials, and items that is common to more than one section of Division 28.
- H. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- I. Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS. Requirements for commissioning - systems readiness checklists, and training.
- J. Section 31 20 00 - EARTH MOVING. For bedding of conduits.

**1.03 DEFINITIONS**

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. FMC: Flexible metal conduit.
- E. IMC: Intermediate metal conduit.
- F. LFMC: Liquidtight flexible metal conduit.
- G. LFNC: Liquidtight flexible nonmetallic conduit.
- H. NBR: Acrylonitrile-butadiene rubber.
- I. RNC: Rigid nonmetallic conduit.

#### **1.04 QUALITY ASSURANCE**

- A. Refer to Paragraph 1.4 Quality Assurance, in Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.

#### **1.05 SUBMITTALS**

- A. Submit in accordance with Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Furnish the following:
  - B. Shop Drawings:
    - 1. Size and location of main feeders;
    - 2. Size and location of panels and pull boxes
    - 3. Layout of required conduit penetrations through structural elements.
    - 4. The specific item proposed and its area of application shall be identified on the catalog cuts.
  - C. Certification: Prior to final inspection, deliver to the Resident Engineer/COTR four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.
  - D. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.
  - E. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
  - F. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
  - G. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
    - 1. Structural members in the paths of conduit groups with common supports.
    - 2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

#### **1.06 APPLICABLE PUBLICATIONS**

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. National Electrical Manufacturers Association (NEMA):
  - 1. TC-3-04 - PVC Fittings for Use with Rigid PVC Conduit and Tubing
  - 2. FBI-07 - Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
- C. National Fire Protection Association (NFPA):
  - 1. 70-11 - National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL):
  - 1. 1-05 - Flexible Metal Conduit
  - 2. 5-04 - Surface Metal Raceway and Fittings
  - 3. 6-07 - Rigid Metal Conduit
  - 4. 50-07 - Enclosures for Electrical Equipment
  - 5. 360-09 - Liquid-Tight Flexible Steel Conduit
  - 6. 467-07 - Grounding and Bonding Equipment
  - 7. 514A-04 - Metallic Outlet Boxes
  - 8. 314B-04 - Fittings for Cable and Conduit

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9. 541C-02 - Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
10. 651-05 - Schedule 40 and 80 Rigid PVC Conduit
11. 651A-07 - Type EB and A Rigid PVC Conduit and HDPE Conduit
12. 797-07 - Electrical Metallic Tubing
13. 1242-06 - Intermediate Metal Conduit

## **PART 2 - PRODUCTS**

### **2.01 GENERAL**

- A. Conduit Size: In accordance with the NEC, but not less than 20 mm (3/4 inch) unless otherwise shown.

### **2.02 CONDUIT**

- A. Rigid galvanized steel: Shall Conform to UL 6, ANSI C80.1.
- B. Rigid aluminum: Shall Conform to UL 6A, ANSI C80.5.
- C. Rigid intermediate steel conduit (IMC): Shall Conform to UL 1242, ANSI C80.6.
- D. Electrical metallic tubing (EMT): Shall Conform to UL 797, ANSI C80.3. Maximum size not to exceed 105 mm (4 inches) and shall be permitted only with cable rated 600 volts or less.
- E. Flexible galvanized steel conduit: Shall Conform to UL 1.
- F. Liquid-tight flexible metal conduit: Shall Conform to UL 360.
- G. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).

### **2.03 WIREWAYS AND RACEWAYS**

- A. Surface metal raceway: Shall Conform to UL 5.

### **2.04 CONDUIT FITTINGS**

- A. Rigid steel and IMC conduit fittings:
  1. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
  2. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
  3. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
  4. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
  5. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
  6. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.
- B. Rigid aluminum conduit fittings:
  1. Standard threaded couplings, locknuts, bushings, and elbows: Malleable iron, steel or aluminum alloy materials; Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
  2. Locknuts and bushings: As specified for rigid steel and IMC conduit.
  3. Set screw fittings: Not permitted for use with aluminum conduit.
- C. Electrical metallic tubing fittings:
  1. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
  2. Only steel or malleable iron materials are acceptable.

3. Couplings and connectors: Concrete tight and rain tight, with connectors having insulated throats. Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller. Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches). Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
  4. Indent type connectors or couplings are prohibited.
  5. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
- D. Flexible steel conduit fittings:
1. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
  2. Clamp type, with insulated throat.
- E. Liquid-tight flexible metal conduit fittings:
1. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
  2. Only steel or malleable iron materials are acceptable.
  3. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
- F. Direct burial plastic conduit fittings:
1. Fittings shall meet the requirements of UL 514C and NEMA TC3.
  2. As recommended by the conduit manufacturer.
- G. Surface metal raceway fittings: As recommended by the raceway manufacturer.
- H. Expansion and deflection couplings:
1. Conform to UL 467 and UL 514B.
  2. Accommodate, 19 mm (0.75 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
  3. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, and the NEC code tables for ground conductors.
  4. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.

## **2.05 CONDUIT SUPPORTS**

- A. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.
- B. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
- C. Multiple conduit (trapeze) hangers: Not less than 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 12 gage steel, cold formed, lipped channels; with not less than 9 mm (3/8 inch) diameter steel hanger rods.
- D. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.

## **2.06 OUTLET, JUNCTION, AND PULL BOXES**

- A. UL-50 and UL-514A.
- B. Cast metal where required by the NEC or shown, and equipped with rustproof boxes.
- C. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- D. Metal Floor Boxes: Cast or sheet metal, semi-adjustable, rectangular.
- E. Sheet metal boxes: Galvanized steel, except where otherwise shown.
- F. Flush mounted wall or ceiling boxes shall be installed with raised covers so that front face of raised cover is flush with the wall. Surface mounted wall or ceiling boxes shall be installed with surface style flat or raised covers.



## **2.07 CABINETS**

- A. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
- B. Hinged door in front cover with flush latch and concealed hinge.
- C. Key latch to match panelboards.
- D. Metal barriers to separate wiring of different systems and voltage.
- E. Accessory feet where required for freestanding equipment.

## **2.08 WIREWAYS**

- A. Equip with hinged covers, except where removable covers are shown.

## **2.09 WARNING TAPE**

- A. Standard, 4-Mil polyethylene 76 mm (3 inches) wide tape non-detectable type, red with black letters, and imprinted with "CAUTION BURIED ELECTRONIC SAFETY AND SECURITY CABLE BELOW".

## **2.10 SLEEVES FOR RACEWAYS**

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.
- C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 84 00 "FIRESTOPPING."

## **2.11 SLEEVE SEALS**

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
  - 1. Sealing Elements: [EPDM] [NBR] interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
  - 2. Pressure Plates: [Plastic] [Carbon steel] [Stainless steel]. Include two for each sealing element.
  - 3. Connecting Bolts and Nuts: [Carbon steel with corrosion-resistant coating] [Stainless steel] of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## **2.12 GROUT**

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time. WIRELINE DATA TRANSMISSION MEDIA FOR SECURITY SYSTEMS

## **PART 3 - EXECUTION**

### **3.01 PENETRATIONS**

- A. Cutting or Holes:
  - 1. Locate holes in advance where they are proposed in the structural sections such as ribs or beams. Obtain the approval of the Resident Engineer/COTR prior to drilling through structural sections.
  - 2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the Resident Engineer/COTR as required by limited working space.

- B. Fire Stop: Where conduits, wireways, and other electronic safety and security raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING, with rock wool fiber or silicone foam sealant only. Completely fill and seal clearances between raceways and openings with the fire stop material.
- C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight as specified in Section 07 92 00, "JOINT SEALANTS".

### 3.02 INSTALLATION, GENERAL

- A. Install conduit as follows:
  - 1. In complete runs before pulling in cables or wires.
  - 2. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
  - 3. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
  - 4. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
  - 5. Mechanically continuous.
  - 6. Independently support conduit at 2.4 m (8 foot) on center. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts).
  - 7. Support within 300 mm (12 inches) of changes of direction, and within 300 mm (12 inches) of each enclosure to which connected.
  - 8. Close ends of empty conduit with plugs or caps at the rough-in stage to prevent entry of debris, until wires are pulled in.
  - 9. Conduit installations under fume and vent hoods are prohibited.
  - 10. Secure conduits to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
  - 11. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, "FLASHING AND SHEET METAL".
  - 12. Do not use aluminum conduits in wet locations.
  - 13. Unless otherwise indicated on the drawings or specified herein, all conduits shall be installed concealed within finished walls, floors and ceilings.
- B. Conduit Bends:
  - 1. Make bends with standard conduit bending machines.
  - 2. Conduit hickey may be used for slight offsets, and for straightening stubbed out conduits.
  - 3. Bending of conduits with a pipe tee or vise is prohibited.
- C. Layout and Homeruns:
  - 1. Install conduit with wiring, including homeruns, as shown.
  - 2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the Resident Engineer/COTR.
- D. Fire Alarm:
  - 1. Fire alarm conduit shall be painted red (a red "top-coated" conduit from the conduit manufacturer may be used in lieu of painted conduit) in accordance with the requirements of Section 28 31 00, "FIRE DETECTION AND ALARM".

### 3.03 CONCEALED WORK INSTALLATION

- A. In Concrete:
  - 1. Conduit: Rigid steel, IMC or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel or vapor barriers.

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2. Align and run conduit in direct lines.
  3. Install conduit through concrete beams only when the following occurs:
    - a. Where shown on the structural drawings.
    - b. As approved by the Resident Engineer/COTR prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
  4. Installation of conduit in concrete that is less than 75 mm (3 inch) thick is prohibited.
    - a. Conduit outside diameter larger than 1/3 of the slab thickness is prohibited.
    - b. Space between conduits in slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.
    - c. Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (3/4 inch) of concrete around the conduits.
  5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to insure low resistance ground continuity through the conduits. Tightening set screws with pliers is prohibited.
- B. Furred or Suspended Ceilings and in Walls:
1. Conduit for conductors above 600 volts:
    - a. Rigid steel or rigid aluminum.
    - b. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.
  2. Conduit for conductors 600 volts and below:
    - a. Rigid steel, IMC, rigid aluminum, or EMT. Different type conduits mixed indiscriminately in the same system is prohibited.
  3. Align and run conduit parallel or perpendicular to the building lines.
  4. Connect recessed lighting fixtures to conduit runs with maximum 1800 mm (6 feet) of flexible metal conduit extending from a junction box to the fixture.
  5. Tightening set screws with pliers is prohibited.

### 3.04 EXPOSED WORK INSTALLATION

- A. Unless otherwise indicated on the drawings, exposed conduit is only permitted in mechanical and electrical rooms.
- B. Conduit for Conductors 600 volts and below:
  1. Rigid steel, IMC, rigid aluminum, or EMT. Different type of conduits mixed indiscriminately in the system is prohibited.
- C. Align and run conduit parallel or perpendicular to the building lines.
- D. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
- E. Support horizontal or vertical runs at not over 2400 mm (eight foot) intervals.
- F. Surface metal raceways: Use only where shown.
- G. Painting:
  1. Paint exposed conduit as specified in Section 09 91 00, "PAINTING".
  2. Paint all conduits containing cables rated over 600 volts safety orange. Refer to Section 09 91 00, "PAINTING" for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (two inch) high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.

### 3.05 EXPANSION JOINTS

- A. Conduits 75 mm (3 inches) and larger, that are secured to the building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
- B. Provide conduits smaller than 75 mm (3 inches) with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to

produce 125 mm (5 inch) vertical drop midway between the ends. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 375 mm (15 inches) and larger conduits are acceptable.

- C. Install expansion and deflection couplings where shown.

### **3.06 CONDUIT SUPPORTS, INSTALLATION**

- A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.
- B. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.
- C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other approved fasteners.
- D. Support conduit independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
- E. Fasteners and Supports in Solid Masonry and Concrete:
  - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
  - 2. Existing Construction:
    - a. Steel expansion anchors not less than 6 mm (1/4 inch) bolt size and not less than 28 mm (1-1/8 inch) embedment.
    - b. Power set fasteners not less than 6 mm (1/4 inch) diameter with depth of penetration not less than 75 mm (3 inches).
    - c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
- F. Hollow Masonry: Toggle bolts are permitted.
- G. Bolts supported only by plaster or gypsum wallboard are not acceptable.
- H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- K. Spring steel type supports or fasteners are prohibited for all uses except: Horizontal and vertical supports/fasteners within walls.
- L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

### **3.07 BOX INSTALLATION**

- A. Boxes for Concealed Conduits:
  - 1. Flush mounted.
  - 2. Provide raised covers for boxes to suit the wall or ceiling, construction and finish.
- B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.
- C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
- D. Outlet boxes in the same wall mounted back-to-back are prohibited. A minimum 600 mm (24 inch), center-to-center lateral spacing shall be maintained between boxes).

- E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 100 mm (4 inches) square by 55 mm (2-1/8 inches) deep, with device covers for the wall material and thickness involved.
- F. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1".
- G. On all Branch Circuit junction box covers, identify the circuits with black marker.

**3.08 ELECTRONIC SAFETY AND SECURITY CONDUIT**

- A. Install the electronic safety and security raceway system as shown on drawings.
- B. Minimum conduit size of 19 mm (3/4 inch), but not less than the size shown on the drawings.
- C. All conduit ends shall be equipped with insulated bushings.
- D. All 100 mm (four inch) conduits within buildings shall include pull boxes after every two 90 degree bends. Size boxes per the NEC.
- E. Vertical conduits/sleeves through closets floors shall terminate not less than 75 mm (3 inches) below the floor and not less than 75 mm (3 inches) below the ceiling of the floor below.
- F. Terminate conduit runs to/from a backboard in a closet or interstitial space at the top or bottom of the backboard. Conduits shall enter communication closets next to the wall and be flush with the backboard.
- G. Where drilling is necessary for vertical conduits, locate holes so as not to affect structural sections such as ribs or beams.
- H. All empty conduits located in communications closets or on backboards shall be sealed with a standard non-hardening duct seal compound to prevent the entrance of moisture and gases and to meet fire resistance requirements.
- I. Conduit runs shall contain no more than four quarter turns (90 degree bends) between pull boxes/backboards. Minimum radius of communication conduit bends shall be as follows (special long radius):

SIZES OF CONDUIT TRADE SIZE	RADIUS OF CONDUIT BENDS MM, INCHES
3/4	150 (6)
1	230 (9)
1-1/4	350 (14)
1-1/2	430 (17)
2	525 (21)
2-1/2	635 (25)
3	775 (31)
3-1/2	900 (36)
4	1125 (45)

- J. Furnish and install 19 mm (3/4 inch) thick fire retardant plywood specified in on the wall of communication closets where shown on drawings . Mount the plywood with the bottom edge 300 mm (one foot) above the finished floor.
- K. Furnish and pull wire in all empty conduits. (Sleeves through floor are exceptions).

**3.09 COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of Section 28 08 00 – “COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS” for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.

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- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 28 08 00, "COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS" and related sections for contractor responsibilities for system commissioning.

**END OF SECTION**

**SECTION 280800.01**  
**DVA/USACE PROJECTS COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS**  
**PART 1 - GENERAL**

**1.01 DESCRIPTION**

- A. The requirements of this Section apply to all sections of Division 28.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00.01 DVA/USACE Projects GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00.01 DVA/USACE Projects GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the Government and Commissioning Manager (CxM) as indicated in Section 01 91 00.01 DVA/USACE Projects GENERAL COMMISSIONING REQUIREMENTS will manage the commissioning process.

**1.02 RELATED WORK**

- A. UFGS GENERAL REQUIREMENTS sections
- B. Section 01 91 00.01 DVA/USACE Projects GENERAL COMMISSIONING REQUIREMENTS
- C. UFGS Section 01 33 00 SUBMITTAL PROCEDURES

**1.03 SUMMARY**

- A. This Section includes requirements for commissioning the Facility electronic safety and security systems, related subsystems and related equipment. This Section supplements the general requirements specified in Section 01 91 00.01 DVA/USACE Projects GENERAL COMMISSIONING REQUIREMENTS.
- B. Refer to Section 01 91 00.01 DVA/USACE GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

**1.04 DEFINITIONS**

- A. Refer to Section 01 91 00.01 DVA/USACE Projects GENERAL COMMISSIONING REQUIREMENTS for definitions.

**1.05 COMMISSIONED SYSTEMS**

- A. Commissioning of a system or systems specified in Division 28 is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00.01 DVA/USACE Projects GENERAL COMMISSIONING REQUIREMENTS and of Division 28, is required in cooperation with the DVA/USACE and the CxA and CxM.
- B. The Facility exterior closure systems commissioning will include the systems listed in Section 01 91 00.01 DVA/USACE Projects GENERAL COMMISSIONING REQUIREMENTS:

**1.06 SUBMITTALS**

- A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The CxA will provide a list of submittals that will be reviewed by the CxA and CxM. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to UFGS Section 01 33 00 SUBMITTAL PROCEDURES for further details.
- B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00.01 DVA/USACE GENERAL COMMISSIONING REQUIREMENTS.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION**

**3.01 CONSTRUCTION INSPECTIONS**

- A. Commissioning of Electronic Safety and Security systems will require inspection of individual elements of the electronic safety and security systems throughout the construction period. The Contractor shall coordinate with the CxA and CxM in accordance with Section 01 91 00.01 DVA/USACE Projects GENERAL COMMISSIONING REQUIREMENTS and the Commissioning plan to schedule electronic safety and security systems inspections as required to support the Commissioning Process.

**3.02 PRE-FUNCTIONAL CHECKLISTS**

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The CxM will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the DVA/USACE, CxA, and CxM for review. The CxM and CxA may spot check a sample of completed checklists. If the CxM and CxA determine that the information provided on the checklist is not accurate, the CxM will return the marked-up checklist to the Contractor for correction and resubmission. If the CxM and CxA determine that a significant number of completed checklists for similar equipment are not accurate, the CxM in coordination with CxA will select a broader sample of checklists for review. If the CxM and CxA determine that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00.01 DVA/USACE Projects GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

**3.03 CONTRACTORS TESTS**

- A. Contractor tests as required by other sections of Division 28 shall be scheduled and documented in accordance with UFGS GENERAL REQUIREMENTS sections. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The CxM will witness selected Contractor tests at the sole discretion of the CxM and CxA. The CxA and other Government representative(s) may choose to participate in some or all the testing procedures as observers. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

**3.04 SYSTEMS FUNCTIONAL PERFORMANCE TESTING**

- A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The CxM will prepare final and detailed Systems Functional Performance Test procedures for review and approval by the CxA and COR. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The CxM will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00.01 DVA/USACE Projects GENERAL COMMISSIONING REQUIREMENTS, for additional details.



**3.05 TRAINING OF VA PERSONNEL**

- A. Training of the VA operation and maintenance personnel is required in cooperation with the COR, VA Resident Engineer, and CxM. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 91 00.01 DVA/USACE Projects GENERAL COMMISSIONING REQUIREMENTS. The instruction shall be scheduled in coordination with the COR and VA Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00.01 DVA/USACE Projects GENERAL COMMISSIONING REQUIREMENTS and Division 28 Sections for additional Contractor training requirements.

**END OF SECTION**

**SECTION 280800**  
**COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS**

**PART 1 - GENERAL**

**1.01 DESCRIPTION**

- A. The requirements of this Section apply to all sections of Division 28.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the VA will manage the commissioning process.

**1.02 RELATED WORK**

- A. Section 01 00 00 GENERAL REQUIREMENTS.
- B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.
- C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

**1.03 SUMMARY**

- A. This Section includes requirements for commissioning the Facility electronic safety and security systems, related subsystems and related equipment. This Section supplements the general requirements specified in Section 01 91 00 General Commissioning Requirements.
- B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

**1.04 DEFINITIONS**

- A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

**1.05 COMMISSIONED SYSTEMS**

- A. Commissioning of a system or systems specified in Division 28 is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 28, is required in cooperation with the VA and the Commissioning Agent.
- B. The Facility exterior closure systems commissioning will include the systems listed in Section 01 91 00 General Commissioning Requirements:

**1.06 SUBMITTALS**

- A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.
- B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION**

**3.01 CONSTRUCTION INSPECTIONS**

- A. Commissioning of Electronic Safety and Security systems will require inspection of individual elements of the electronic safety and security systems throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 91 00

and the Commissioning plan to schedule electronic safety and security systems inspections as required to support the Commissioning Process.

### **3.02 PRE-FUNCTIONAL CHECKLISTS**

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

### **3.03 CONTRACTORS TESTS**

- A. Contractor tests as required by other sections of Division 28 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

### **3.04 SYSTEMS FUNCTIONAL PERFORMANCE TESTING**

- A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

### **3.05 TRAINING OF VA PERSONNEL**

- A. Training of the VA operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 91 00. The instruction shall be scheduled in coordination with the VA Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 28 Sections for additional Contractor training requirements.

**END OF SECTION**

**SECTION 281300  
PHYSICAL ACCESS CONTROL SYSTEM**

**PART 1 – GENERAL**

**1.01 DESCRIPTION**

- A. This section specifies the finishing, installation, connection, testing and certification of a complete and fully operating Physical Access Control System, hereinafter referred to as the PACS.
- B. This Section includes a Physical Access Control System consisting of a system server, [one or more networked workstation computers,] operating system and application software, and field-installed Controllers connected by a high-speed electronic data transmission network. The PACS shall have the following:
  - 1. Physical Access Control:
    - a. Regulating access through doors
    - b. Anti-passback
    - c. Visitor assignment
    - d. Surge and tamper protection
    - e. Secondary alarm annunciator
    - f. Credential cards and readers
    - g. Biometric identity verification equipment
    - h. Push-button switches
    - i. RS-232 ASCII interface
    - j. Credential creation and credential holder database and management
    - k. Monitoring of field-installed devices
    - l. Interface with paging and HVAC systems.
    - m. Reporting
  - 2. Security:
    - a. Real-time guard tour.
    - b. Time and attendance.
    - c. Key tracking.
    - d. Video and camera control.
    - e. Time and attendance
- C. System Architecture:
  - 1. Criticality, operational requirements, and/or limiting points of failure may dictate the development of an enterprise and regional server architecture as opposed to system capacity. Provide server and workstation configurations with all necessary connectors, interfaces and accessories as shown.
- D. PACS shall provide secure and reliable identification of Federal employees and contractors by utilizing credential authentication per FIPS-201.
- E. Physical Access Control System (PACS) shall consist of:
  - 1. Head-End equipment server,
  - 2. One or more networked PC-based workstations,
  - 3. Physical Access Control System and Database Management Software,
  - 4. Credential validation software/hardware,
  - 5. Field installed controllers,
  - 6. PIV Middleware,
  - 7. Card readers,
  - 8. Biometric identification devices,
  - 9. PIV cards,
  - 10. Supportive information system,
  - 11. Door locks and sensors,

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12. Power supplies,
13. Interfaces with:
  - a. Video Surveillance and Assessment System,
  - b. Automatic door operators,
  - c. Intrusion Detection System,
  - d. Intercommunication System
  - e. Fire Protection System,
  - f. HVAC,
  - g. Building Management System,
- F. Head-End equipment server, workstations and controllers shall be connected by a high-speed electronic data transmission network.
- G. Information system supporting PACS , Head-End equipment server, workstations, network switches, routers and controllers shall comply with FIPS 200 requirements (Minimum Security Requirements for Federal Information and Information Systems)and NIST Special Publication 800-53 (Recommended Security Controls for Federal Information Systems).
- H. PACS system shall support:
  1. Multiple credential authentication modes,
  2. Bidirectional communication with the reader,
  3. Incident response policy implementation capability; system shall have capability to automatically change access privileges for certain user groups to high security areas in case of incident/emergency.
  4. Visitor management,
- I. All security relevant decisions shall be made on "secure side of the door". Secure side processing shall include;
  1. Challenge/response management,
  2. PKI path discovery and validation,
  3. Credential identifier processing,
  4. Authorization decisions.
- J. For locations where secure side processing is not applicable the tamper switches and certified cryptographic processing shall be provided per FIPS-140-2.
- K. System Software: Based on central-station, workstation operating system, server operating system, and application software.
- L. Software and controllers shall be capable of matching full 56 bit FASC-N plus minimum of 32 bits of public key certificate data.
- M. Software shall have the following capabilities:
  1. Multiuser multitasking to allow for independent activities and monitoring to occur simultaneously at different workstations.
  2. Support authentication and enrollment;
    - a. PIV verification,
    - b. Expiration date check,
    - c. Biometric check,
    - d. Digital photo display/check,
    - e. Validate digital signatures of data objects (Objects are signed by the Trusted Authority
    - f. Private key challenge (CAK & PAK to verify private key public key pairs exist and card is not a clone)
  3. Support CRL validation via OCSP or SCVP on a scheduled basis and automatically deny access to any revoked credential in the system.
  4. Graphical user interface to show pull-down menus and a menu tree format that complies with interface guidelines of Microsoft Windows operating system.

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5. System license shall be for the entire system and shall include capability for future additions that are within the indicated system size limits specified in this Section.
  6. System shall have open architecture that allows importing and exporting of data and interfacing with other systems that are compatible with operating system.
  7. Operator login and access shall be utilized via integrated smart card reader and password protection.
- N. Systems Networks:
1. A standalone system network shall interconnect all components of the system. This network shall include communications between a central station and any peer or subordinate workstations, enrollment stations, local annunciation stations, portal control stations or redundant central stations.
- O. Security Management System Server Redundancy:
1. The SMS shall support multiple levels of fault tolerance and SMS redundancy listed and described below:
    - a. Hot Standby Servers
    - b. Clustering
    - c. Disk Mirroring
    - d. RAID Level 10
    - e. Distributed Intelligence
- P. Number of points:
1. PACS shall support multiple autonomous regional servers that can connect to a master command and controller server.
  2. Unlimited number of access control readers, unlimited number of inputs or outputs, unlimited number of client workstations, unlimited number of cardholders.
  3. Total system solution to enable enterprise-wide, networked, multi-user access to all system resources via a wide range of options for connectivity with the customer's existing LAN and WAN.
- Q. Console Network:
1. Console network, if required, shall provide communication between a central station and any subordinate or separate stations of the system. Where redundant central or parallel stations are required, the console network shall allow the configuration of stations as master and slave. The console network may be a part of the field device network or may be separate depending upon the manufacturer's system configuration.
- R. Network(s) connecting PCs and Controllers shall comply with NIST Special Publication 800-53 (Recommended Security Controls for Federal Information Systems) and consist of one or more of the following:
1. Local area, IEEE 802.3 Fast Ethernet 10 BASE-T, 100 BASE-TX, star topology network based on TCP/IP.
  2. Direct-connected, RS-232 cable from the COM port of the Central Station to the first Controller, then RS-485 to interconnect the remainder of the Controllers at that Location.

**1.02 RELATED WORK**

1. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
2. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping application and use.
3. Section 08 35 13.13 - ACCORDIAN FOLDING DOORS. Requirements for door installation.
4. Section 08 71 00 - DOOR HARDWARE. Requirements for door installation.
5. Section 10 14 00 - SIGNAGE. Requirements for labeling and signs.
6. Section 28 05 00 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. For general requirements that are common to more than one section in Division 28.

7. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.
8. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.
9. Section 28 05 28.33 - CONDUITS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.
10. Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY. For requirements for commissioning, systems readiness checklists, and training.
11. Section 28 13 16 - ACCESS CONTROL SYSTEM AND DATABASE MANAGEMENT. Requirements for control and operation of all security systems.
12. Section 28 13 53 - SECURITY ACCESS DETECTION. Requirements for screening of personnel and shipments.
13. Section 28 16 00 - INTRUSION DETECTION SYSTEM (IDS). Requirements for alarm systems.
14. Section 28 23 00 - VIDEO SURVEILLANCE. Requirements for security camera systems.
15. Section 28 26 00 - ELECTRONIC PERSONAL PROTECTION SYSTEM (EPPS). Requirements for emergency and interior communications.

### 1.03 QUALITY ASSURANCE

- A. The Contractor shall be responsible for providing, installing, and the operation of the PACS as shown. The Contractor shall also provide certification as required.
- B. The security system will be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the security system is stand-alone or a part of a complete Information Technology (IT) computer network.
- C. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.
- D. Product Qualifications
  1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
  2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.
- E. Contractor Qualifications:
  1. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years experience installing and servicing systems of similar scope and complexity. The Contractor shall be an authorized regional representative of the Security Management System's (PACS) manufacturer. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity which became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system. The references must include a current point of contact, company or agency name, address, telephone number, complete system description, date of completion, and approximate cost of the project. The owner reserves the option to visit the reference sites, with the site owner's permission and representative, to verify the quality of installation and the references' level of satisfaction with the system. The Contractor shall provide copies of system manufacturer certification for all technicians. The Contractor shall only utilize factory-trained technicians to install, program, and service the PACS. The Contractor shall only utilize factory-trained technicians to install, terminate and service controller/field panels and reader modules. The technicians shall have a minimum of five (5) continuous years of technical experience in electronic security systems. The Contractor shall have a local service facility. The facility shall be located within 60 miles of the project site. The local facility shall include sufficient spare parts inventory to support the service

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requirements associated with this contract. The facility shall also include appropriate diagnostic equipment to perform diagnostic procedures. The Resident Engineer reserves the option of surveying the company's facility to verify the service inventory and presence of a local service organization.

- a. The Contractor shall provide proof project superintendent with BICSI Certified Commercial Installer Level 1, Level 2, or Technician to provide oversight of the project.
  - b. Cable installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International. The staff member shall provide consistent oversight of the project cabling throughout design, layout, installation, termination and testing.
- F. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within eight hours of receipt of notification that service is needed. Submit name and address of service organizations.

#### 1.04 SUBMITTALS

- A. Submit below items in conjunction with Master Specification Sections 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, Section 02 41 00, DEMOLITION, and Section 28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
- B. Provide certificates of compliance with Section 1.3, Quality Assurance.
- C. Provide a complete and thorough pre-installation and as-built design package in both electronic format and on paper, minimum size 48 x 48 inches (1220 x 1220 millimeters); drawing submittals shall be per the established project schedule.
- D. Shop drawing and as-built packages shall include, but not be limited to:
  1. Index Sheet that shall:
    - a. Define each page of the design package to include facility name, building name, floor, and sheet number.
    - b. Provide a complete list of all security abbreviations and symbols.
    - c. Reference all general notes that are utilized within the design package.
    - d. Specification and scope of work pages for all individual security systems that are applicable to the design package that will:
      - 1) Outline all general and job specific work required within the design package.
      - 2) Provide a detailed device identification table outlining device Identification (ID) and use for all security systems equipment utilized in the design package.
  2. Drawing sheets that will be plotted on the individual floor plans or site plans shall:
    - a. Include a title block as defined above.
    - b. Clearly define the drawings scale in both standard and metric measurements.
    - c. Provide device identification and location.
    - d. Address all signal and power conduit runs and sizes that are associated with the design of the electronic security system and other security elements (e.g., barriers, etc.).
    - e. Identify all pull box and conduit locations, sizes, and fill capacities.
    - f. Address all general and drawing specific notes for a particular drawing sheet.
  3. A detailed riser drawing for each applicable security subsystem shall:
    - a. Indicate the sequence of operation.
    - b. Relationship of integrated components on one diagram.
    - c. Include the number, size, identification, and maximum lengths of interconnecting wires.
    - d. Wire/cable types shall be defined by a wire and cable schedule. The schedule shall utilize a lettering system that will correspond to the wire/cable it represents (example: A = 18 AWG/1 Pair Twisted, Unshielded). This schedule shall also provide the



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- manufacturer's name and part number for the wire/cable being installed.
4. A detailed system drawing for each applicable security system shall:
    - a. Clearly identify how all equipment within the system, from main panel to device, shall be laid out and connected.
    - b. Provide full detail of all system components wiring from point-to-point.
    - c. Identify wire types utilized for connection, interconnection with associate security subsystems.
    - d. Show device locations that correspond to the floor plans.
    - e. All general and drawing specific notes shall be included with the system drawings.
  5. A detailed schedule for all of the applicable security subsystems shall be included. All schedules shall provide the following information:
    - a. Device ID.
    - b. Device Location (e.g. site, building, floor, room number, location, and description).
    - c. Mounting type (e.g. flush, wall, surface, etc.).
    - d. Power supply or circuit breaker and power panel number.
    - e. In addition, for the PACS, provide the door ID, door type (e.g. wood or metal), locking mechanism (e.g. strike or electromagnetic lock) and control device (e.g. card reader or biometrics).
  6. Detail and elevation drawings for all devices that define how they were installed and mounted.
- E. Pre-installation design packages shall go through a full review process conducted by the Contractor along with a VA representative to ensure all work has been clearly defined and completed. All reviews shall be conducted in accordance with the project schedule. There shall be four (4) stages to the review process:
1. 35 percent
  2. 65 percent
  3. 90 percent
  4. 100 percent
- F. Provide manufacturer security system product cut-sheets. Submit for approval at least 30 days prior to commencement of formal testing, a Security System Operational Test Plan. Include procedures for operational testing of each component and security subsystem, to include performance of an integrated system test.
- G. Submit manufacture's certification of Underwriters Laboratories, Inc. (UL) listing as specified. Provide all maintenance and operating manuals per Section 01 00 00, GENERAL REQUIREMENTS, and Section 28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
- H. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.
- I. General: Submittals shall be in full compliance of the Contract Documents. All submittals shall be provided in accordance with this section. Submittals lacking the breath or depth these requirements will be considered incomplete and rejected. Submissions are considered multidisciplinary and shall require coordination with applicable divisions to provide a complete and comprehensive submission package. Additional general provisions are as follows:
1. The Contractor shall schedule submittals in order to maintain the project schedule. For coordination drawings refer to Specification Section 01 33 10 - DESIGN SUBMITTAL PROCEDURES, which outline basic submittal requirements and coordination. Section 01 33 10 shall be used in conjunction with this section.
  2. The Contractor shall identify variations from requirements of Contract Documents and state product and system limitations, which may be detrimental to successful performance of the completed work or system.

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3. Each package shall be submitted at one (1) time for each review and include components from applicable disciplines (e.g., electrical work, architectural finishes, door hardware, etc.) which are required to produce an accurate and detailed depiction of the project.
4. Manufacturer's information used for submittal shall have pages with items for approval tagged, items on pages shall be identified, and capacities and performance parameters for review shall be clearly marked through use of an arrow or highlighting. Provide space for Resident Engineer and Contractor review stamps.
5. Technical Data Drawings shall be in the latest version of AutoCAD®, drawn accurately, and in accordance with VA CAD Standards. **FREEHAND SKETCHES OR COPIED VERSIONS OF THE CONSTRUCTION DOCUMENTS WILL NOT BE ACCEPTED.** The Contractor shall not reproduce Contract Documents or copy standard information as the basis of the Technical Data Drawings. If departures from the technical data drawings are subsequently deemed necessary by the Contractor, details of such departures and the reasons thereof shall be submitted in writing to the Resident Engineer for approval before the initiation of work.
6. Packaging: The Contractor shall organize the submissions according to the following packaging requirements.
  - a. Binders: For each manual, provide heavy duty, commercial quality, durable three (3) ring vinyl covered loose leaf binders, sized to receive 8.5 x 11 in paper, and appropriate capacity to accommodate the contents. Provide a clear plastic sleeve on the spine to hold labels describing the contents. Provide pockets in the covers to receive folded sheets.
    - 1) Where two (2) or more binders are necessary to accommodate data, correlate data in each binder into related groupings according to the Project Manual table of contents. Cross-referencing other binders where necessary to provide essential information for communication of proper operation and or maintenance of the component or system.
    - 2) Identify each binder on the front and spine with printed binder title, Project title or name, and subject matter covered. Indicate the volume number if applicable.
  - b. Dividers: Provide heavy paper dividers with celluloid tabs for each Section. Mark each tab to indicate contents.
  - c. Protective Plastic Jackets: Provide protective transparent plastic jackets designed to enclose diagnostic software for computerized electronic equipment.
  - d. Text Material: Where written material is required as part of the manual use the manufacturer's standard printed material, or if not available, specially prepared data, neatly typewritten on 8.5 inches by 11 inches 20 pound white bond paper.
  - e. Drawings: Where drawings and/or diagrams are required as part of the manual, provide reinforced punched binder tabs on the drawings and bind them with the text.
    - 1) Where oversized drawings are necessary, fold the drawings to the same size as the text pages and use as a foldout.
    - 2) If drawings are too large to be used practically as a foldout, place the drawing, neatly folded, in the front or rear pocket of the binder. Insert a type written page indicating the drawing title, description of contents and drawing location at the appropriate location of the manual.
    - 3) Drawings shall be sized to ensure details and text is of legible size. Text shall be no less than 1/16-inch tall.
  - f. Manual Content: In each manual include information specified in the individual Specification section, and the following information for each major component of building equipment and controls:
    - 1) General system or equipment description.
    - 2) Design factors and assumptions.
    - 3) Copies of applicable Shop Drawings and Product Data.
    - 4) System or equipment identification including: manufacturer, model and serial numbers of each component, operating instructions, emergency instructions,

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- wiring diagrams, inspection and test procedures, maintenance procedures and schedules, precautions against improper use and maintenance, repair instructions, sources of required maintenance materials and related services, and a manual index.
- g. Binder Organization: Organize each manual into separate sections for each piece of related equipment. At a minimum, each manual shall contain a title page, table of contents, copies of Product Data supplemented by drawings and written text, and copies of each warranty, bond, certifications, and service Contract issued. Refer to Group I through V Technical Data Package Submittal requirements for required section content.
  - h. Title Page: Provide a title page as the first sheet of each manual to include the following information; project name and address, subject matter covered by the manual, name and address of the Project, date of the submittal, name, address, and telephone number of the Contractor, and cross references to related systems in other operating and/or maintenance manuals.
  - i. Table of Contents: After the title page, include a type written table of contents for each volume, arranged systematically according to the Project Manual format. Provide a list of each product included, identified by product name or other appropriate identifying symbols and indexed to the content of the volume. Where more than one (1) volume is required to hold data for a particular system, provide a comprehensive table of contents for all volumes in each volume of the set.
  - j. General Information Section: Provide a general information section immediately following the table of contents, listing each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the installer and maintenance Contractor. In addition, list a local source for replacement parts and equipment.
  - k. Drawings: Provide specially prepared drawings where necessary to supplement the manufacturers printed data to illustrate the relationship between components of equipment or systems, or provide control or flow diagrams. Coordinate these drawings with information contained in Project Record Drawings to assure correct illustration of the completed installation.
  - l. Manufacturer's Data: Where manufacturer's standard printed data is included in the manuals, include only those sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation. Where more than one (1) item in tabular format is included, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation and delete references to information which is not applicable.
  - m. Where manufacturer's standard printed data is not available and the information is necessary for proper operation and maintenance of equipment or systems, or it is necessary to provide additional information to supplement the data included in the manual, prepare written text to provide the necessary information. Organize the text in a consistent format under a separate heading for different procedures. Where necessary, provide a logical sequence of instruction for each operating or maintenance procedure. Where similar or more than one product is listed on the submittal the Contractor shall differentiate by highlighting the specific product to be utilized.
  - n. Calculations: Provide a section for circuit and panel calculations.
  - o. Loading Sheets: Provide a section for DGP Loading Sheets.
  - p. Certifications: Provide section for Contractor's manufacturer certifications.
7. Contractor Review: Review submittals prior to transmittal. Determine and verify field measurements and field construction criteria. Verify manufacturer's catalog numbers and conformance of submittal with requirements of contract documents. Return non-conforming or incomplete submittals with requirements of the work and contract documents. Apply Contractor's stamp with signature certifying the review and verification

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- of products occurred, and the field dimensions, adjacent construction, and coordination of information is in accordance with the requirements of the contract documents.
8. Resubmission: Revise and resubmit submittals as required within 15 calendar days of return of submittal. Make resubmissions under procedures specified for initial submittals. Identify all changes made since previous submittal.
  9. Product Data: Within 15 calendar days after execution of the contract, the Contractor shall submit for approval a complete list of all of major products proposed for use. The data shall include name of manufacturer, trade name, model number, the associated contract document section number, paragraph number, and the referenced standards for each listed product.
- J. Group 1 Technical Data Package: Group I Technical Data Package shall be one submittal consisting of the following content and organization. Refer to VA Special Conditions Document for drawing format and content requirements. The data package shall include the following:
1. Section I - Drawings:
    - a. General – Drawings shall conform to VA Special Conditions and CAD Standards Documents. All text associated with security details shall be 1/8" tall and meet VA text standard for AutoCAD™ drawings.
    - b. Cover Sheet – Cover sheet shall consist of Project Title and Address, Project Number, Area and Vicinity Maps.
    - c. General Information Sheets – General Information Sheets shall consist of General Notes, Abbreviations, Symbols, Wire and Cable Schedule, Project Phasing, and Sheet Index.
    - d. Floor Plans – Floor plans shall be produced from the Architectural backgrounds issued in the Construction Documents. The contractor shall receive floor plans from the prime A/E to develop these drawing sets. Security devices shall be placed on drawings in scale. All text associated with security details shall be 1/8" tall and meet VA text standard for AutoCAD™ drawings. Floor plans shall identify the following:
      - 1) security devices by symbol,
      - 2) the associated device point number (derived from the loading sheets),
      - 3) wire & cable types and counts
      - 4) conduit sizing and routing
      - 5) conduit riser systems
      - 6) device and area detail call outs
    - e. Architectural details – Architectural details shall be produced for each device mounting type (door details for doors with physical access control, reader pedestals and mounts, security panel and power supply details).
    - f. Riser Diagrams – Contractor shall provide a riser diagram indicating riser architecture and distribution of the physical access control system throughout the facility (or area in scope).
    - g. Block Diagrams – Contractor shall provide a block diagram for the entire system architecture and interconnections with SMS subsystems. Block diagram shall identify SMS subsystem (e.g., physical access control, intrusion detection, closed circuit television, intercom, and other associated subsystems) integration; and data transmission and media conversion methodologies.
    - h. Interconnection Diagrams – Contractor shall provide interconnection diagram for each sensor, and device component. Interconnection diagram shall identify termination locations, standard wire detail to include termination schedule. Diagram shall also identify interfaces to other systems such as fire alarm systems, and security management systems.
    - i. Security Details:
      - 1) Panel Assembly Detail – For each panel assembly, a panel assembly details shall be provided identifying individual panel component size and content.

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- 2) Panel Details – Provide security panel details identify general arrangement of the security system components, backboard size, wire through size and location, and power circuit requirements.
- 3) Device Mounting Details – Provide mounting detailed drawing for each security device (physical access control system, intrusion detection, video surveillance and assessment, and intercom systems) for each type of wall and ceiling configuration in project. Device details shall include device, mounting detail, wiring and conduit routing.
- 4) Details of connections to power supplies and grounding
- 5) Details of surge protection device installation
- 6) Sensor detection patterns – Each system sensor shall have associated detection patterns.
- 7) Equipment Rack Detail – For each equipment rack, provide a scaled detail of the equipment rack location and rack space utilization. Use of BISC wire management standards shall be employed to identify wire management methodology. Transitions between equipment racks shall be shown to include use vertical and horizontal latter rack system.
- 8) Security Control Room – The contractor shall provide a layout plan for the Security Control Room. The layout plan shall identify all equipment and details associated with the installation.
- 9) Operator Console – The contractor shall provide a layout plan for the Operator Console. The layout plan shall identify all equipment and details associated with the installation. Equipment room - the contractor shall provide a layout plan for the equipment room. The layout plan shall identify all equipment and details associated with the installation.
- 10) Equipment Room – Equipment room details shall provide architectural, electrical, mechanical, plumbing, IT/Data and associated equipment and device placements both vertical and horizontally.
- j. Electrical Panel Schedule – Electrical Panel Details shall be provided for all SMS systems electrical power circuits. Panel details shall be provided identifying panel type (Standard, Emergency Power, Emergency/Uninterrupted Power Source, and Uninterrupted Power Source Only), panel location, circuit number, and circuit amperage rating.
- k. Door Schedule – A door schedule shall be developed for each door equipped with electronic security components. At a minimum, the door schedule shall be coordinated with Division 08 work and include the following information:
  - 1) Item Number
  - 2) Door Number (Derived from A/E Drawings)
  - 3) Floor Plan Sheet Number
  - 4) Standard Detail Number
  - 5) Door Description (Derived from Loading Sheets)
  - 6) Data Gathering Panel Input Number
  - 7) Door Position or Monitoring Device Type & Model Number
  - 8) Lock Type, Model Number & Power Input/Draw (standby/active)
  - 9) Card Reader Type & Model Number
  - 10) Shunting Device Type & Model Number
  - 11) Sounder Type & Model Number
  - 12) Manufacturer
  - 13) Misc. devices as required
    - (a) Delayed Egress Type & Model Number
    - (b) Intercom
    - (c) Camera
    - (d) Electric Transfer Hinge

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- (e) Electric Pass-through device
- 14) Remarks column indicating special notes or door configurations
- 2. Camera Schedule - A camera schedule shall be developed for each camera. Contractors shall coordinate with the Resident Engineer to determine camera starting numbers and naming conventions. All drawings shall identify wire and cable standardization methodology. Color coding of all wiring conductors and jackets is required and shall be communicated consistently throughout the drawings package submittal. At a minimum, the camera schedule shall include the following information:
  - a. Item Number
  - b. Camera Number
  - c. Naming Conventions
  - d. Description of Camera Coverage
  - e. Camera Location
  - f. Floor Plan Sheet Number
  - g. Camera Type
  - h. Mounting Type
  - i. Standard Detail Reference
  - j. Power Input & Draw
  - k. Power Panel Location
  - l. Remarks Column for Camera
- 3. Section II – Data Gathering Panel Documentation Package
  - a. Contractor shall provide Data Gathering Panel (DGP) input and output documentation packages for review at the Shop Drawing submittal stage and also with the as-built documentation package. The documentation packages shall be provided in both printed and magnetic form at both review stages.
  - b. The Contractor shall provide loading sheet documentation package for the associated DGP, including input and output boards for all field panels associated with the project. Documentation shall be provided in current version Microsoft Excel spreadsheets following the format currently utilized by VA. A separate spreadsheet file shall be generated for each DGP and associated field panels.
  - c. The spreadsheet names shall follow a sequence that shall display the spreadsheets in numerical order according to the DGP system number. The spreadsheet shall include the prefix in the file name that uniquely identifies the project site. The spreadsheet shall detail all connected items such as card readers, alarm inputs, and relay output connections. The spreadsheet shall include an individual section (row) for each panel input, output and card reader. The spreadsheet shall automatically calculate the system numbers for card readers, inputs, and outputs based upon data entered in initialization fields.
  - d. All entries must be verified against the field devices. Copies of the floor plans shall be forwarded under separate cover.
  - e. The DGP spreadsheet shall include an entry section for the following information:
    - 1) DGP number
    - 2) First Reader Number
    - 3) First Monitor Point Number
    - 4) First Relay Number
    - 5) DGP, input or output Location
    - 6) DGP Chain Number
    - 7) DGP Cabinet Tamper Input Number
    - 8) DGP Power Fail Input Number
    - 9) Number of Monitor Points Reserved For Expansion Boards
    - 10) Number of Control Points (Relays) Reserved For Expansion Boards
  - f. The DGP, input module and output module spreadsheets shall automatically calculate the following information based upon the associated entries in the above

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fields:

- 1) System Numbers for Card Readers
  - 2) System Numbers for Monitor Point Inputs
  - 3) System Numbers for Control Points (Relays)
  - 4) Next DGP or input module First Monitor Point Number
  - 5) Next DGP or output module First Control Point Number
- g. The DGP spreadsheet shall provide the following information for each card reader:
- 1) DGP Reader Number
  - 2) System Reader Number
  - 3) Cable ID Number
  - 4) Description Field (Room Number)
  - 5) Description Field (Device Type i.e.: In Reader, Out Reader, etc.)
  - 6) Description Field
  - 7) DGP Input Location
  - 8) Date Test
  - 9) Date Passed
  - 10) Cable Type
  - 11) Camera Numbers (of cameras viewing the reader location)
- h. The DGP and input module spreadsheet shall provide the following information for each monitor point (alarm input).
- 1) DGP Monitor Point Input Number
  - 2) System Monitor Point Number
  - 3) Cable ID Number
  - 4) Description Field (Room Number)
  - 5) Description Field (Device Type i.e.: Door Contact, Motion Detector, etc.)
  - 6) DGP or input module Input Location
  - 7) Date Test
  - 8) Date Passed
  - 9) Cable Type
  - 10) Camera Numbers (of associated alarm event preset call-ups)
- i. The DGP and output module spreadsheet shall provide the following information for each control point (output relay).
- 1) DGP Control Point (Relay) Number
  - 2) System (Control Point) Number
  - 3) Cable ID Number
  - 4) Description Field (Room Number)
  - 5) Description Field (Device: Lock Control, Local Sounder, etc.)
  - 6) Description Field
  - 7) DGP or OUTPUT MODULE Output Location
  - 8) Date Test
  - 9) Date Passed Cable Type
  - 10) Camera Number (of associated alarm event preset call-ups)
- j. The DGP, input module and output module spreadsheet shall include the following information or directions in the header and footer:
- 1) Header
    - (a) DGP Input and Output Worksheet
    - (b) Enter Beginning Reader, Input, and Output Starting Numbers and Sheet Will Automatically Calculate the Remaining System Numbers.
  - 2) Footer
    - (a) File Name
    - (b) Date Printed
    - (c) Page Number

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4. Section III - Construction Mock-up: In areas with exposed EMT/Conduit Raceways, contractor shall conceal raceway as much as practical and unobtrusively. In addition, historic significance must be considered to determine installation means and methods for approval by the owner.
  5. Section IV - Manufacturers' Data: The data package shall include manufacturers' data for all materials and equipment, including sensors, local processors and console equipment provided under this specification.
  6. Section V - System Description and Analysis: The data package shall include system descriptions, analysis, and calculations used in sizing equipment required by these specifications. Descriptions and calculations shall show how the equipment will operate as a system to meet the performance requirements of this specification. The data package shall include the following:
    - a. Central processor memory size; communication speed and protocol description; rigid disk system size and configuration; flexible disk system size and configuration; back-up media size and configuration; alarm response time calculations; command response time calculations; start-up operations; expansion capability and method of implementation; sample copy of each report specified; and color photographs representative of typical graphics.
    - b. Software Data: The data package shall consist of descriptions of the operation and capability of the system, and application software as specified.
    - c. Overall System Reliability Calculations: The data package shall include all manufacturers' reliability data and calculations required to show compliance with the specified reliability.
  7. Section VI – Certifications & References: All specified manufacturer's certifications shall be included with the data package. Contractor shall provide Project references as outlined in Paragraph 1.4 "Quality Assurance".
- K. Group II Technical Data Package
1. The Contractor shall prepare a report of "Current Site Conditions" and submit a report to the Resident Engineer documenting changes to the site, particularly those conditions that affect performance of the system to be installed. The Contractor shall provide specification sheets, or written functional requirements to support the findings, and a cost estimate to correct those site changes or conditions which affect the installation of the system or its performance. The Contractor shall not correct any deficiency without written permission from the COTR.
  2. System Configuration and Functionality: The contractor shall provide the results of the meeting with VA to develop system requirements and functionality including but not limited to:
    - a. Baseline configuration
    - b. Access levels
    - c. Schedules (intrusion detection, physical access control, holidays, etc.)
    - d. Badge database
    - e. System monitoring and reporting (unit level and central control)
    - f. Naming conventions and descriptors
- L. Group III Technical Data Package
1. Development of Test Procedures: The Contractor will prepare performance test procedures for the system testing. The test procedures shall follow the format of the VA Testing procedures and be customized to the contract requirements. The Contractor will deliver the test procedures to the Resident Engineer for approval at least 60 calendar days prior to the requested test date.
- M. Group IV Technical Data Package
1. Performance Verification Test
    - a. Based on the successful completion of the pre-delivery test, the Contractor shall finalize the test procedures and report forms for the performance verification test



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(PVT) and the endurance test. The PVT shall follow the format, layout and content of the pre-delivery test. The Contractor shall deliver the PVT and endurance test procedures to the Resident Engineer for approval. The Contractor may schedule the PVT after receiving written approval of the test procedures. The Contractor shall deliver the final PVT and endurance test reports within 14 calendar days from completion of the tests. Refer to Part 3 of this section for System Testing and Acceptance requirements.

2. Training Documentation
  - a. New Facilities and Major Renovations: Familiarization training shall be provided for new equipment or systems. Training can include site familiarization training for VA technicians and administrative personnel. Training shall include general information on new system layout including closet locations, turnover of the completed system including all documentation, including manuals, software, key systems, and full system administration rights. Lesson plans and training manuals training shall be oriented to type of training to be provided.
  - b. New Unit Control Room:
    - 1) Provide the security personnel with training in the use, operation, and maintenance of the entire control room system (Unit Control and Equipment Rooms). The training documentation must include the operation and maintenance. The first of the training sessions shall take place prior to system turnover and the second immediately after turnover. Coordinate the training sessions with the Owner. Completed classroom sessions will be witnessed and documented by the Architect/Engineer, and approved by the Resident Engineer. Instruction is not to begin until the system is operational as designed.
    - 2) The training documents will cover the operation and the maintenance manuals and the control console operators' manuals and service manuals in detail, stressing all important operational and service diagnostic information necessary for the maintenance and operations personnel to efficiently use and maintain all systems.
    - 3) Provide an illustrated control console operator's manual and service manual. The operator's manual shall be written in laymen's language and printed so as to become a permanent reference document for the operators, describing all control panel switch operations, graphic symbol definitions and all indicating functions and a complete explanation of all software.
    - 4) The service manual shall be written in laymen's language and printed so as to become a permanent reference document for maintenance personnel, describing how to run internal self diagnostic software programs, troubleshoot head end hardware and field devices with a complete scenario simulation of all possible system malfunctions and the appropriate corrective measures.
    - 5) Provide a professional color DVD instructional recording of all the operational procedures described in the operator's manual. All charts used in the training session shall be clearly presented on the video. Any DVD found to be inferior in recording or material content shall be reproduced at no cost until an acceptable DVD is submitted. Provide four copies of the training DVD, one to the architect/engineer and three to the owner.
3. System Configuration and Data Entry:
  - a. The contractor is responsible for providing all system configuration and data entry for the SMS and subsystems (e.g., video matrix switch, intercom, digital video recorders, network video recorders). All data entry shall be performed per VA standards & guidelines. The Contractor is responsible for participating in all meetings with the client to compile the information needed for data entry. These meetings shall be established at the beginning of the project and incorporated in to the project schedule as a milestone task. The contractor shall be responsible for all data collection, data entry, and system configuration. The contractor shall collect, enter, & program and/or

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- configure the following components:
- 1) Physical Access control system components,
  - 2) All intrusion detection system components,
  - 3) Video surveillance, control and recording systems,
  - 4) Intercom systems components,
  - 5) All other security subsystems shown in the contract documents.
- b. The Contractor is responsible for compiling the card access database for the VA employees, including programming reader configurations, access shifts, schedules, exceptions, card classes and card enrollment databases.
- c. Refer to Part 3 for system programming requirements and planning guidelines.
4. Graphics: Based on CAD as-built drawings developed for the construction project, create all map sets showing locations of all alarms and field devices. Graphical maps of all alarm points installed under this contract including perimeter and exterior alarm points shall be delivered with the system. The Contractor shall create and install all graphics needed to make the system operational. The Contractor shall utilize data from the contract documents, Contractor's field surveys, and all other pertinent information in the Contractor's possession to complete the graphics. The Contractor shall identify and request from the COTR, any additional data needed to provide a complete graphics package. Graphics shall have sufficient level of detail for the system operator to assess the alarm. The Contractor shall supply hard copy, color examples at least 203.2 x 254 mm (8 x 10 in) of each type of graphic to be used for the completed Security system. The graphics examples shall be delivered to the Resident Engineer for review and approval at least 90 calendar days prior to the scheduled date the Contractor requires them.
- N. Group V Technical Data Package: Final copies of the manuals shall be delivered to the Resident Engineer as part of the acceptance test. The draft copy used during site testing shall be updated with any changes required prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each sub-contractor installing equipment or systems, as well as the nearest service representatives for each item of equipment for each system. The manuals shall include a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the endurance test shall include all modifications made during installation, checkout, and acceptance. Six (6) hard-copies and one (1) soft copy on CD of each item listed below shall be delivered as a part of final systems acceptance.
1. Functional Design Manual: The functional design manual shall identify the operational requirements for the entire system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included for all system operating modes. Manufacturer developed literature may be used; however, shall be produced to match the project requirements.
  2. Equipment Manual: A manual describing all equipment furnished including:
    - a. General description and specifications; installation and checkout procedures; equipment electrical schematics and layout drawings; system schematics and layout drawings; alignment and calibration procedures; manufacturer's repair list indicating sources of supply; and interface definition.
  3. Software Manual: The software manual shall describe the functions of all software and include all other information necessary to enable proper loading, testing, and operation. The manual shall include:
    - a. Definition of terms and functions; use of system and applications software; procedures for system initialization, start-up, and shutdown; alarm reports; reports generation, database format and data entry requirements; directory of all disk files; and description of all communications protocols including data formats, command characters, and a sample of each type of data transfer.
  4. Operator's Manual: The operator's manual shall fully explain all procedures and instructions for the operation of the system, including:

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- a. Computers and peripherals; system start-up and shutdown procedures; use of system, command, and applications software; recovery and restart procedures; graphic alarm presentation; use of report generator and generation of reports; data entry; operator commands' alarm messages, and printing formats; and system access requirements.
5. Maintenance Manual: The maintenance manual shall include descriptions of maintenance for all equipment including inspection, recommend schedules, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.
6. Spare Parts & Components Data: At the conclusion of the Contractor's work, the Contractor shall submit to the Resident Engineer a complete list of the manufacturer's recommended spare parts and components required to satisfactorily maintain and service the systems, as well as unit pricing for those parts and components.
7. Operation, Maintenance & Service Manuals: The Contractor shall provide two (2) complete sets of operating and maintenance manuals in the form of an instructional manual for use by the VA Security Guard Force personnel. The manuals shall be organized into suitable sets of manageable size. Where possible, assemble instructions for similar equipment into a single binder. If multiple volumes are required, each volume shall be fully indexed and coordinated.
8. Equipment and Systems Maintenance Manual: The Contractor shall provide the following descriptive information for each piece of equipment, operating system, and electronic system:
  - a. Equipment and/or system function.
  - b. Operating characteristics.
  - c. Limiting conditions.
  - d. Performance curves.
  - e. Engineering data and test.
  - f. Complete nomenclature and number of replacement parts.
  - g. Provide operating and maintenance instructions including assembly drawings and diagrams required for maintenance and a list of items recommended to stock as spare parts.
  - h. Provide information detailing essential maintenance procedures including the following: routine operations, trouble shooting guide, disassembly, repair and re-assembly, alignment, adjusting, and checking.
  - i. Provide information on equipment and system operating procedures, including the following; start-up procedures, routine and normal operating instructions, regulation and control procedures, instructions on stopping, shut-down and emergency instructions, required sequences for electric and electronic systems, and special operating instructions.
  - j. Manufacturer equipment and systems maintenance manuals are permissible.
9. Project Redlines: During construction, the Contractor shall maintain an up-to-date set of construction redlines detailing current location and configuration of the project components. The redline documents shall be marked with the words 'Master Redlines' on the cover sheet and be maintained by the Contractor in the project office. The Contractor will provide access to redline documents anytime during the project for review and inspection by the Resident Engineer or authorized Office of Protection Services representative. Master redlines shall be neatly maintained throughout the project and secured under lock and key in the contractor's onsite project office. Any project component or assembly that is not installed in strict accordance with the drawings shall be so noted on the drawings. Prior to producing Record Construction Documents, the contractor will submit the Master Redline document to the Resident Engineer for review and approval of all changes or modifications to the documents. Each sheet shall have Resident Engineer initials indicating authorization to produce "As Built" documents. Field drawings shall be used for data gathering & field changes. These changes shall be made to the master redline documents daily. Field drawings shall not be considered "master

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- redlines”.
10. Record Specifications: The Contractor shall maintain one (1) copy of the Project Specifications, including addenda and modifications issued, for Project Record Documents. The Contractor shall mark the Specifications to indicate the actual installation where the installation varies substantially from that indicated in the Contract Specifications and modifications issued. (Note related Project Record Drawing information where applicable). The Contractor shall pay particular attention to substitutions, selection of product options, and information on concealed installations that would be difficult to identify or measure and record later. Upon completion of the mark ups, the Contractor shall submit record Specifications to the COTR. As with master relines, Contractor shall maintain record specifications for Resident Engineer review and inspection at anytime.
  11. Record Product Data: The Contractor shall maintain one (1) copy of each Product Data submittal for Project Record Document purposes. The Data shall be marked to indicate the actual product installed where the installation varies substantially from that indicated in the Product Data submitted. Significant changes in the product delivered to the site and changes in manufacturer's instructions and recommendations for installation shall be included. Particular attention will be given to information on concealed products and installations that cannot be readily identified or recorded later. Note related Change Orders and mark up of Record Construction Documents, where applicable. Upon completion of mark up, submit a complete set of Record Product Data to the COTR.
  12. Miscellaneous Records: The Contractor shall maintain one (1) copy of miscellaneous records for Project Record Document purposes. Refer to other Specifications for miscellaneous record-keeping requirements and submittals concerning various construction activities. Before substantial completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for use and reference. Categories of requirements resulting in miscellaneous records include, a minimum of the following:
    - a. Certificates received instead of labels on bulk products.
    - b. Testing and qualification of tradesmen. (“Contractor’s Qualifications”)
    - c. Documented qualification of installation firms.
    - d. Load and performance testing.
    - e. Inspections and certifications.
    - f. Final inspection and correction procedures.
    - g. Project schedule
  13. Record Construction Documents (Record As-Built)
    - a. Upon project completion, the contractor shall submit the project master redlines to the Resident Engineer prior to development of Record construction documents. The Resident Engineer shall be given a minimum of a thirty (30) day review period to determine the adequacy of the master redlines. If the master redlines are found suitable by the Resident Engineer, the Resident Engineer will initial and date each sheet and turn redlines over to the contractor for as built development.
    - b. The Contractor shall provide the Resident Engineer a complete set of "as-built" drawings and original master redlined marked "as-built" blue-line in the latest version of AutoCAD drawings unlocked on CD or DVD. The as-built drawing shall include security device number, security closet connection location, data gathering panel number, and input or output number as applicable. All corrective notations made by the Contractor shall be legible when submitted to the COTR. If, in the opinion of the COTR, any redlined notation is not legible, it shall be returned to the Contractor for re-submission at no extra cost to the Owner. The Contractor shall organize the Record Drawing sheets into manageable sets bound with durable paper cover sheets with suitable titles, dates, and other identifications printed on the cover. The submitted as built shall be in editable formats and the ownership of the drawings shall be fully relinquished to the owner.

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- c. Where feasible, the individual or entity that obtained record data, whether the individual or entity is the installer, sub-contractor, or similar entity, is required to prepare the mark up on Record Drawings. Accurately record the information in a comprehensive drawing technique. Record the data when possible after it has been obtained. For concealed installations, record and check the mark up before concealment. At the time of substantial completion, submit the Record Construction Documents to the COTR. The Contractor shall organize into bound and labeled sets for the COTR's continued usage. Provide device, conduit, and cable lengths on the conduit drawings. Exact in-field conduit placement/routings shall be shown. All conduits shall be illustrated in their entire length from termination in security closets; no arrowed conduit runs shall be shown. Pull box and junction box sizes are to be shown if larger than 100mm (4 inch).
- O. FIPS 201 Compliance Certificates
  1. Provide Certificates for all software components and device types utilizing credential verification. Provide certificates for:
    - a. Fingerprint Capture Station
    - b. Card Readers
    - c. Facial Image Capturing Camera
    - d. PIV Middleware
    - e. Template Matcher
    - f. Electromagnetically Opaque Sleeve
    - g. Certificate Management
      - 1) CAK Authentication System
      - 2) PIV Authentication System
      - 3) Certificate Validator
      - 4) Cryptographic Module
- P. Approvals will be based on complete submission of manuals together with shop drawings.
- Q. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.
- R. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- S. American National Standards Institute (ANSI)/ Security Industry Association (SIA):
  1. AC-03 - Access Control: Access Control Guideline Dye Sublimation Printing Practices for PVC Access Control Cards
  2. TVAC-01 - CCTV to Access Control Standard - Message Set for System Integration
- T. American National Standards Institute (ANSI)/ International Code Council (ICC):
  1. A117.1 - Standard on Accessible and Usable Buildings and Facilities
- U. Department of Justice American Disability Act (ADA)
  1. 28 CFR Part 36 - ADA Standards for Accessible Design 2010
- V. Department of Veterans Affairs (VA):
  1. PACS-R - Physical Access Control System (PACS) Requirements
  2. VA Handbook 0730 - Security and Law Enforcement

#### 1.05 DEFINITIONS

- A. Authentication: A process that establishes the origin of information, or determines an entity's identity. In this publication, authentication often means the performance of a PIV authentication mechanism.

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- B. Authenticator: A memory, possession, or quality of a person that can serve as proof of identity, when presented to a verifier of the appropriate kind. For example, passwords, cryptographic keys, and fingerprints are authenticators.
- C. Authorization: A process that associates permission to access a resource or asset with a person and the person's identifier(s).
- D. BIO or BIO-A: A FIPS 201 authentication mechanism that is implemented by using a Fingerprint data object sent from the PIV Card to the PACS. Note that the short-hand "BIO (-A)" is used throughout the document to represent both BIO and BIO-A authentication mechanisms.
- E. Biometric: An authenticator produced from measurable qualities of a living person.
- F. CAC EP – CAC End Point with end point PIV applet
- G. CAC NG – CAC Next Generation with transitional PIV applet
- H. Card Authentication Key (CAK): A PIV authentication mechanism (or the PIV Card key of the same name) that is implemented by an asymmetric or symmetric key challenge/response protocol. The CAK is an optional mechanism defined in NIST SP 800-73. [SP800-73] NIST strongly recommends that every PIV Card contain an asymmetric CAK and corresponding certificate, and that agencies use the asymmetric CAK protocol, rather than a symmetric CAK protocol, whenever the CAK authentication mechanism is used with PACS.
- I. CCTV: Closed-circuit television.
- J. Central Station: A PC with software designated as the main controlling PC of the PACS. Where this term is presented with initial capital letters, this definition applies.
- K. Controller: An intelligent peripheral control unit that uses a computer for controlling its operation. Where this term is presented with an initial capital letter, this definition applies.
- L. CPU: Central processing unit.
- M. Credential: Data assigned to an entity and used to identify that entity.
- N. File Server: A PC in a network that stores the programs and data files shared by users.
- O. FIPS Federal Information Processing Standards
- P. FRAC – First Responder Authentication Credential
- Q. HSPD Homeland Security Presidential Directive
- R. I/O: Input/Output.
- S. Identifier: A credential card, keypad personal identification number or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.
- T. IEC International Electrotechnical Commission
- U. ISO International Organization for Standardization
- V. KB Kilobyte
- W. kbit/s Kilobits / second
- X. LAN: Local area network.
- Y. LED: Light-emitting diode.
- Z. Legacy CAC – Contact only Common Access Card with v1 and v2 applets
- AA. Location: A Location on the network having a PC-to-Controller communications link, with additional Controllers at the Location connected to the PC-to-Controller link with RS-485 communications loop. Where this term is presented with an initial capital letter, this definition applies.
- BB. NIST: National Institute of Standards and Technology

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- CC. PACS: Physical Access Control System
- DD. PC/SC: Personal Computer / Smart Card
- EE. PC: Personal computer. This acronym applies to the Central Station, workstations, and file servers.
- FF. PCI Bus: Peripheral component interconnect; a peripheral bus providing a high-speed data path between the CPU and peripheral devices (such as monitor, disk drive, or network).
- GG. PDF: (Portable Document Format.) The file format used by the Acrobat document exchange system software from Adobe.
- HH. PIV: Personal Identification Verification
- II. PIV-I – PIV Interoperable credential
- JJ. PPS: Protocol and Parameters Selection
- KK. RF: Radio frequency.
- LL. ROM: Read-only memory. ROM data are maintained through losses of power.
- MM. RS-232: An TIA/EIA standard for asynchronous serial data communications between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.
- NN. RS-485: An TIA/EIA standard for multipoint communications.
- OO. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
- PP. TPDU: Transport Protocol Data Unit
- QQ. TWIC – Transportation Worker Identification Credential
- RR. UPS: Uninterruptible power supply.
- SS. Vcc: Voltage at the Common Collector
- TT. WAN: Wide area network.
- UU. WAV: The digital audio format used in Microsoft Windows.
- VV. Wiegand: Patented magnetic principle that uses specially treated wires embedded in the credential card.
- WW. Windows: Operating system by Microsoft Corporation.
- XX. Workstation: A PC with software that is configured for specific limited security system functions.

#### **1.06 COORDINATION**

- A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed.

#### **1.07 MAINTENANCE & SERVICE**

- A. General Requirements

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1. The Contractor shall provide all services required and equipment necessary to maintain the entire integrated electronic security system in an operational state as specified for a period of one (1) year after formal written acceptance of the system. The Contractor shall provide all necessary material required for performing scheduled adjustments or other non-scheduled work. Impacts on facility operations shall be minimized when performing scheduled adjustments or other non-scheduled work. See also General Project Requirements.
- B. Description of Work
1. The adjustment and repair of the security system includes all software updates, panel firmware, and the following new items computers equipment, communications transmission equipment and data transmission media (DTM), local processors, security system sensors, physical access control equipment, facility interface, signal transmission equipment, and video equipment.
- C. Personnel
1. Service personnel shall be certified in the maintenance and repair of the selected type of equipment and qualified to accomplish all work promptly and satisfactorily. The Resident Engineer shall be advised in writing of the name of the designated service representative, and of any change in personnel. The Resident Engineer shall be provided copies of system manufacturer certification for the designated service representative.
- D. Schedule of Work
1. The work shall be performed during regular working ours, Monday through Friday, excluding federal holidays. These inspections shall include:
    - a. The Contractor shall perform two (2) minor inspections at six (6) month intervals or more if required by the manufacturer, and two (2) major inspections offset equally between the minor inspections to effect quarterly inspection of alternating magnitude.
      - 1) Minor Inspections shall include visual checks and operational tests of all console equipment, peripheral equipment, local processors, sensors, electrical and mechanical controls, and adjustments on printers.
      - 2) Major Inspections shall include all work described for Minor Inspections and the following: clean all system equipment and local processors including interior and exterior surfaces; perform diagnostics on all equipment; operational tests of the CPU, switcher, peripheral equipment, recording devices, monitors, picture quality from each camera; check, walk test, and calibrate each sensor; run all system software diagnostics and correct all problems; and resolve any previous outstanding problems.
- E. Emergency Service
1. The owner shall initiate service calls whenever the system is not functioning properly. The Contractor shall provide the Owner with an emergency service center telephone number. The emergency service center shall be staffed 24 hours a day 365 days a year. The Owner shall have sole authority for determining catastrophic and non-catastrophic system failures within parameters stated in General Project Requirements.
    - a. For catastrophic system failures, the Contractor shall provide same day four (4) hour service response with a defect correction time not to exceed eight (8) hours from [notification] [arrival on site]. Catastrophic system failures are defined as any system failure that the Owner determines will place the facility(s) at increased risk.
    - b. For non-catastrophic failures, the Contractor within eight (8) hours with a defect correction time not to exceed 24 hours from notification.
- F. Operation
1. Performance of scheduled adjustments and repair shall verify operation of the system as demonstrated by the applicable portions of the performance verification test.
- G. Records & Logs



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1. The Contractor shall maintain records and logs of each task and organize cumulative records for each component and for the complete system chronologically. A continuous log shall be submitted for all devices. The log shall contain all initial settings, calibration, repair, and programming data. Complete logs shall be maintained and available for inspection on site, demonstrating planned and systematic adjustments and repairs have been accomplished for the system.
- H. Work Request
1. The Contractor shall separately record each service call request, as received. The record shall include the serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing the action taken, the amount and nature of the materials used, and the date and time of commencement and completion. The Contractor shall deliver a record of the work performed within five (5) working days after the work was completed.
- I. System Modifications
1. The Contractor shall make any recommendations for system modification in writing to the COTR. No system modifications, including operating parameters and control settings, shall be made without prior written approval from the COTR. Any modifications made to the system shall be incorporated into the operation and maintenance manuals and other documentation affected.
- J. Software
1. The Contractor shall provide all software updates when approved by the Owner from the manufacturer during the installation and 12-month warranty period and verify operation of the system. These updates shall be accomplished in a timely manner, fully coordinated with the system operators, and incorporated into the operations and maintenance manuals and software documentation. There shall be at least one (1) scheduled update near the end of the first year's warranty period, at which time the Contractor shall install and validate the latest released version of the Manufacturer's software. All software changes shall be recorded in a log maintained in the unit control room. An electronic copy of the software update shall be maintained within the log. At a minimum, the contractor shall provide a description of the modification, when the modification occurred, and name and contact information of the individual performing the modification. The log shall be maintained in a white 3 ring binder and the cover marked "SOFTWARE CHANGE LOG".

#### **1.08 PERFORMANCE REQUIREMENTS**

- A. PACS shall provide support for multiple authentication modes and bidirectional communication with the reader. PACS shall provide implementation capability for enterprise security policy and incident response.
- B. All processing of authentication information must occur on the "safe side" of a door
- C. Physical Access Control System shall provide access to following Security Areas:
  1. Controlled
  2. Limited
  3. Exclusion
- D. PACS shall provide:
  1. One authentication factor for access to Controlled security areas
  2. Two authentication factors for access to Limited security areas
  3. Three authentication factors for access to Exclusion security areas
- E. PACS shall provide Credential Validation and Path Validation per NIST 800-116.
- F. The PACS System shall have an Enterprise Path Validation Module (PVM) component that processes X.509 certification paths composed of X.509 v3 certificates and X.509 v2 CRLs. The PVM component MUST support the following features:

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1. Name chaining;
  2. Signature chaining;
  3. Certificate validity;
  4. Key usage, basic constraints, and certificate policies certificate extensions;
  5. Full CRLs; and
  6. CRLs segmented on names.
- G. Distributed Processing: System shall be a fully distributed processing system so that information, including time, date, valid codes, access levels, and similar data, is downloaded to Controllers so that each Controller makes access-control decisions for that Location. Do not use intermediate Controllers for physical access control. If communications to Central Station are lost, all Controllers shall automatically buffer event transactions until communications are restored, at which time buffered events shall be uploaded to the Central Station.
- H. Number of Locations: Support unlimited number of separate Locations using a single PC with combinations of direct-connect, dial-up, or TCP/IP LAN connections to each Location.
1. Each Location shall have its own database and history in the Central Station. Locations may be combined to share a common database.
- I. Data Capacity:
1. [130] different card-reader formats.
  2. [999] comments.
  3. [16] graphic file types for importing maps.
- J. Location Capacity:
1. [128] reader-controlled doors.
  2. [50,000] total access credentials.
  3. [2048] supervised alarm inputs.
  4. [2048] programmable outputs.
  5. [32,000] custom action messages per Location to instruct operator on action required when alarm is received.
- K. System Network Requirements:
1. Interconnect system components and provide automatic communication of status changes, commands, field-initiated interrupts, and other communications required for proper system operation.
  2. Communication shall not require operator initiation or response, and shall return to normal after partial or total network interruption such as power loss or transient upset.
  3. System shall automatically annunciate communication failures to the operator and identify the communication link that has experienced a partial or total failure.
  4. Communications Controller may be used as an interface between the Central Station display systems and the field device network. Communications Controller shall provide functions required to attain the specified network communications performance.
- L. Central Station shall provide operator interface, interaction, display, control, and dynamic and real-time monitoring. Central Station shall control system networks to interconnect all system components, including workstations and field-installed Controllers.
- M. Field equipment shall include Controllers, sensors, and controls. Controllers shall serve as an interface between the Central Station and sensors and controls. Data exchange between the Central Station and the Controllers shall include down-line transmission of commands, software, and databases to Controllers. The up-line data exchange from the Controller to the Central Station shall include status data such as intrusion alarms, status reports, and entry-control records. Controllers are classified as alarm-annunciation or entry-control type.
- N. System Response to Alarms: Field device network shall provide a system end-to-end response time of [1] second(s) or less for every device connected to the system. Alarms shall be annunciated at the Central Station within 1 second of the alarm occurring at a Controller or device controlled by a local Controller, and within 100 ms if the alarm occurs at the Central

Station. Alarm and status changes shall be displayed within 100 ms after receipt of data by the Central Station. All graphics shall be displayed, including graphics-generated map displays, on the console monitor within 5 seconds of alarm receipt at the security console.

- O. False Alarm Reduction: The design of Central Station and Controllers shall contain features to reduce false alarms. Equipment and software shall comply with SIA CP-01.
- P. Error Detection: A cyclic code error detection method shall be used between Controllers and the Central Station, which shall detect single- and double-bit errors, burst errors of eight bits or less, and at least 99 percent of all other multibit and burst error conditions. Interactive or product error detection codes alone will not be acceptable. A message shall be in error if one bit is received incorrectly. System shall retransmit messages with detected errors. A two-digit decimal number shall be operator assignable to each communication link representing the number of retransmission attempts. When the number of consecutive retransmission attempts equals the assigned quantity, the Central Station shall print a communication failure alarm message. System shall monitor the frequency of data transmission failure for display and logging.
- Q. Data Line Supervision: System shall initiate an alarm in response to opening, closing, shorting, or grounding of data transmission lines.
- R. Door Hardware Interface: Coordinate with Division 08 Sections that specify door hardware required to be monitored or controlled by the PACS. The Controllers in this Section shall have electrical characteristics that match the signal and power requirements of door hardware. Integrate door hardware specified in Division 08 Sections to function with the controls and PC-based software and hardware in this Section.
- S. References to industry and trade association standards and codes are minimum installation requirement standards.
- T. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

#### **1.09 EQUIPMENT AND MATERIALS**

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.
- B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
  - 1. Components of an assembled unit need not be products of the same manufacturer.
  - 2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
  - 3. Components shall be compatible with each other and with the total assembly for the intended service.
  - 4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Testing Is Specified:
  - 1. The Government shall have the option of witnessing factory tests. The contractor shall notify the VA through the Resident Engineer a minimum of 15 working days prior to the manufacturers making the factory tests.
  - 2. Four copies of certified test reports containing all test data shall be furnished to the Resident Engineer prior to final inspection and not more than 90 days after completion of the tests.
  - 3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the Government.

### **1.10 WARRANTY OF CONSTRUCTION.**

- A. Warrant PACS work subject to the Article "Warranty of Construction" of FAR clause 52.246-21.
- B. Demonstration and training shall be performed prior to system acceptance.

### **1.11 GENERAL REQUIREMENTS**

- A. For general requirements that are common to more than one section in Division 28 refer to Section 28 05 00, REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS.
- B. General requirements applicable to this section include:
  - 1. General Arrangement of Contract Documents,
  - 2. Delivery, Handling and Storage,
  - 3. Project Conditions,
  - 4. Electrical Power,
  - 5. Lightning, Power Surge Suppression, and Grounding,
  - 6. Electronic Components,
  - 7. Substitute Materials and Equipment, and
  - 8. Like Items.

## **PART 2 – PRODUCTS**

### **2.01 GENERAL**

- A. All equipment and materials for the system will be compatible to ensure correct operation as outlined in FIPS 201, March 2006 and HSPD-12.
- B. The security system characteristics listed in this section will serve as a guide in selection of equipment and materials for the PACS. If updated or more suitable versions are available then the Contracting Officer will approve the acceptance of prior to an installation.
- C. PACS equipment shall meet or exceed all requirements listed below.
- D. A PACS shall be comprised of, but not limited to, the following components:
  - 1. Physical Access Control System
  - 2. Application Software
  - 3. System Database
  - 4. Surge and Tamper Protection
  - 5. Standard Workstation Hardware
  - 6. Communications Workstation
  - 7. Controllers (Data Gathering Panel)
  - 8. Secondary Alarm Annunciator
  - 9. Keypads
  - 10. Card Readers
  - 11. Credential Cards
  - 12. Biometric Identity Verification Equipment
  - 13. Enrollment Center (To be provided in accordance with the VA PIV enrollment and issuance system.)
  - 14. System Sensors and Related Equipment
  - 15. Push Button Switches
  - 16. Interfaces
  - 17. Door Hardware interface
  - 18. RS-232 ASCII Interface
  - 19. After-Hours HVAC Control
  - 20. Real Time Guard Tour
  - 21. Video and Camera Control
  - 22. Cables

23. Transformers

**2.02 SECURITY MANAGEMENT SYSTEM (SMS)**

- A. Shall allow the configuration of an enrollment and badging, alarm monitoring, administrative, asset management, digital video management, intrusion detection, visitor enrollment, remote access level management, and integrated client workstations or any combination of all or some.
- B. Shall be expandable to support an unlimited number of individual module or integrated client workstations. All access control field hardware, including Data Gathering Panels(DGP), shall be connected to all physical access control system workstation on the network.
- C. Shall have the ability to compose, file, maintain, update, and print reports for either individuals or the system as follows.
  - 1. Individual reports that consist of an employee's name, office location, phone number or direct extension, and normal hours of operation. The report shall provide a detail listing of the employee's daily events in relation to accessing points within a facility.
  - 2. System reports shall be able to produce information on a daily/weekly/monthly basis for all events, alarms, and any other activity associated with a system user.
- D. All reports shall be in a date/time format and all information shall be clearly presented. Shall be designed to allow it to work with any industry standard network protocol and topology listed below:
  - 1. Transmission Control Protocol (TCP)/IP
  - 2. Novell Netware (IPX/SPX)
  - 3. Banyan VINES
  - 4. IBM LAN Server (NetBEUI)
  - 5. Microsoft LAN Manager (NetBEUI)
  - 6. Network File System (NFS) Networks
  - 7. Remote Access Service (RAS) via ISDN, x.25, and standard phone lines.
- E. Shall provide full interface and control of the PACS to include the following subsystems within the PACS:
  - 1. Public Key Infrastructure
  - 2. Card Management
  - 3. Identity and Access Management
  - 4. Personal Identity Verification
- F. Shall have the following features or compatibilities:
  - 1. The ability to be operated locally or remotely via a LAN, WAN, internet, or intranet.
  - 2. Event and Alarm Monitoring
  - 3. Database Partitioning
  - 4. Ability to fully integrate with all other security subsystems
  - 5. Enhanced Monitoring Station with Split Screen Views
  - 6. Alternate and Extended Shunt by Door
  - 7. Escort Management
  - 8. Enhanced IT-based Password Protection
  - 9. N-man Rule and Occupancy Restrictions
  - 10. Open Journal Data Format for Enhanced Reporting
  - 11. Automated Personnel Import
  - 12. ODBC Support
  - 13. Windows 2000 Professional, Windows Server 2003, Windows XP Professionals for Servers, Windows 7
  - 14. Field-Level Audit Trail
  - 15. Cardholder Access Events

### 2.03 APPLICATION SOFTWARE

- A. System Software: Based on 32-bit Microsoft Windows central-station and workstation operating system and application software. Software shall have the following features:
  - 1. Multiuser multitasking to allow independent activities and monitoring to occur simultaneously at different workstations.
  - 2. Graphical user interface to show pull-down menus and a menu tree format.
  - 3. Capability for future additions within the indicated system size limits.
  - 4. Open architecture that allows importing and exporting of data and interfacing with other systems that are compatible with operating system.
  - 5. Password-protected operator and smart card login and access.
- B. Peer Computer Control Software: Shall detect a failure of a central computer, and shall cause the other central computer to assume control of all system functions without interruption of operation. Drivers shall be provided in both central computers to support this mode of operation.
- C. Application Software: Interface between the alarm annunciation and entry-control Controllers, to monitor sensors[ and DTS links], operate displays, report alarms, generate reports, and help train system operators. Software shall have the following functions:
  - 1. Resides at the Central Station, workstations, and Controllers as required to perform specified functions.
  - 2. Operate and manage peripheral devices.
  - 3. Manage files for disk I/O, including creating, deleting, and copying files; and automatically maintain a directory of all files, including size and location of each sequential and random-ordered record.
  - 4. Import custom icons into graphics views to represent alarms and I/O devices.
  - 5. Globally link I/O so that any I/O can link to any other I/O within the same Location, without requiring interaction with the host PC. This operation shall be at the Controller.
  - 6. Globally code I/O links so that any access-granted event can link to any I/O with the same Location without requiring interaction with the host PC. This operation shall be at the Controller.
  - 7. Messages from PC to Controllers and Controllers to Controllers shall be on a polled network that utilizes check summing and acknowledgment of each message. Communication shall be automatically verified, buffered, and retransmitted if message is not acknowledged.
  - 8. Selectable poll frequency and message time-out settings shall handle bandwidth and latency issues for TCP/IP, RF, and other PC-to-Controller communications methods by changing the polling frequency and the amount of time the system waits for a response.
  - 9. Automatic and encrypted backups for database and history backups shall be automatically stored at the central control PC or a selected workstation and encrypted with a nine-character alphanumeric password, which must be used to restore or read data contained in backup.
  - 10. Operator audit trail for recording and reporting all changes made to database and system software.
- D. Workstation Software:
  - 1. Password levels shall be individually customized at each workstation to allow or disallow operator access to program functions for each Location.
  - 2. Workstation event filtering shall allow user to define events and alarms that will be displayed at each workstation. If an alarm is unacknowledged (not handled by another workstation) for a preset amount of time, the alarm will automatically appear on the filtered workstation.
- E. Controller Software:

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1. Controllers shall operate as an autonomous intelligent processing unit. Controllers shall make decisions about physical access control, alarm monitoring, linking functions, and door locking schedules for its operation, independent of other system components.  
Controllers shall be part of a fully distributed processing control network. The portion of the database associated with a Controller and consisting of parameters, constraints, and the latest value or status of points connected to that Controller, shall be maintained in the Controller.
2. Functions: The following functions shall be fully implemented and operational within each Controller:
  - a. Monitoring inputs.
  - b. Controlling outputs.
  - c. Automatically reporting alarms to the Central Station.
  - d. Reporting of sensor and output status to Central Station on request.
  - e. Maintaining real time, automatically updated by the Central Station at least once a day.
  - f. Communicating with the Central Station.
  - g. Executing Controller resident programs.
  - h. Diagnosing.
  - i. Downloading and uploading data to and from the Central Station.
3. Controller Operations at a Location:
  - a. Location: Up to [64] Controllers connected to RS-485 communications loop. Globally operating I/O linking and anti-passback functions between Controllers within the same Location without central-station or workstation intervention. Linking and anti-passback shall remain fully functional within the same Location even when the Central Station or workstations are off line.
  - b. In the event of communications failure between the Central Station and a Location, there shall be no degradation in operations at the Controllers at that Location. The Controllers at each Location shall be connected to a memory buffer with a capacity to store up to 10,000 events; there shall be no loss of transactions in system history files until the buffer overflows.
  - c. Buffered events shall be handled in a first-in-first-out mode of operation.
4. Individual Controller Operation:
  - a. Controllers shall transmit alarms, status changes, and other data to the Central Station when communications circuits are operable. If communications are not available, Controllers shall function in a stand-alone mode and operational data, including the status and alarm data normally transmitted to the Central Station, shall be stored for later transmission to the Central Station. Storage capacity for the latest 1024 events shall be provided at each Controller.
  - b. Card-reader ports of a Controller shall be custom configurable for at least [120] different card-reader or keypad formats. Multiple reader or keypad formats may be used simultaneously at different Controllers or within the same Controller.
  - c. Controllers shall provide a response to card-readers or keypad entries in less than 0.25 seconds, regardless of system size.
  - d. Controllers that are reset, or powered up from a nonpowered state, shall automatically request a parameter download and reboot to its proper working state. This shall happen without any operator intervention.
  - e. Initial Startup: When Controllers are brought on-line, database parameters shall be automatically downloaded to them. After initial download is completed, only database changes shall be downloaded to each Controller.
  - f. Failure Mode: On failure for any reason, Controllers shall perform an orderly shutdown and force Controller outputs to a predetermined failure mode state, consistent with the failure modes shown and the associated control device.

- g. Startup After Power Failure: After power is restored, startup software shall initiate self-test diagnostic routines, after which Controllers shall resume normal operation.
          - h. Startup After Controller Failure: On failure, if the database and application software are no longer resident, Controllers shall not restart, but shall remain in the failure mode until repaired. If database and application programs are resident, Controllers shall immediately resume operation. If not, software shall be restored automatically from the Central Station.
  - 5. Communications Monitoring:
    - a. System shall monitor and report status of RS-485 communications loop [TCP/IP communication status] of each Location.
    - b. Communication status window shall display which Controllers are currently communicating, a total count of missed polls since midnight, and which Controller last missed a poll.
    - c. Communication status window shall show the type of CPU, the type of I/O board, and the amount of RAM memory for each Controller.
  - 6. Operating systems shall include a real-time clock function that maintains seconds, minutes, hours, day, date, and month. The real-time clock shall be automatically synchronized with the Central Station at least once a day to plus or minus 10 seconds. The time synchronization shall be automatic, without operator action and without requiring system shutdown.
- F. PC-to-Controller Communications:
- 1. Central-station or workstation communications shall use the following:
    - 1) Direct connection using serial ports of the PC.
    - 2) TCP/IP LAN network interface cards.
    - 3) Dial-up modems for connections to Locations.
  - 2. Serial Port Configuration: Each serial port used for communications shall be individually configurable for "direct communications," "modem communications incoming and outgoing," or "modem communications incoming only"; or as an ASCII output port.
  - 3. Multiport Communications Board: Use if more than two serial ports are needed.
    - a. Expandable and modular design. Use a 4-, 8-, or 16-serial port configuration that is expandable to 32 or 64 serial ports.
    - b. Connect the first board to an internal PCI bus adapter card.
  - 4. Direct serial, TCP/IP, and dial-up communications shall be alike in the monitoring or control of system, except for the connection that must first be made to a dial-up Location.
  - 5. TCP/IP network interface card shall have an option to set the poll frequency and message response time-out settings.
  - 6. PC-to-Controller and Controller-to-Controller communications (direct, dial-up, or TCP/IP) shall use a polled-communication protocol that checks sum and acknowledges each message. All communications shall be verified and buffered and retransmitted if not acknowledged.
- G. Direct Serial or TCP/IP PC-to-Controller Communications:
- 1. Communication software on the PC shall supervise the PC-to-Controller communications link.
  - 2. Loss of communications to any Controller shall result in an alarm at all PCs running the communications software.
  - 3. When communications are restored, all buffered events shall automatically upload to the PC, and any database changes shall be automatically sent to the Controller.
- H. Dial-up Modem PC-to-Controller Communications:
- 1. Communication software on the PC shall supervise the PC-to-Controller communications link during dial-up modem connect times.
  - 2. Communication software shall be programmable to routinely poll each of the remote dial-up modem Locations, collecting event logs and verifying phone lines at time intervals that



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- are operator selectable for each Location.
3. System shall be programmable for dialing and connecting to all dial-up modem Locations and for retrieving the accrued history transactions on an automatic basis as often as once every [10] minutes and up to once every [9999] minutes.
  4. Failure to communicate to a dial-up Location three times in a row shall result in an alarm at the PC.
  5. Time offset capabilities shall be present so that Locations in a different geographical time zone than the host PC will be set to, and maintained at, the proper local time. This feature shall allow for geographical time zones that are ahead of or behind the host PC.
  6. The Controller connected to a dial-up modem shall automatically buffer all normal transactions until its buffer reaches 80 percent of capacity. When the transaction buffer reaches 80 percent, the Controller shall automatically initiate a call to the Central Station and upload all transactions.
  7. Alarms shall be reported immediately.
  8. Dial-up modems shall be provided by manufacturer of the system. Modems used at the Controller shall be powered by the Controller. Power to the modem shall include battery backup if the Controller is so equipped.
- I. Controller-to-Controller Communications:
1. Controller-to-Controller Communications: RS-485, 4-wire, point-to-point, regenerative (repeater) communications network methodology.
  2. RS-485 communications signal shall be regenerated at each Controller.
- J. Database Downloads:
1. All data transmissions from PCs to a Location, and between Controllers at a Location, shall include a complete database checksum to check the integrity of the transmission. If the data checksum does not match, a full data download shall be automatically retransmitted.
  2. If a Controller is reset for any reason, it shall automatically request and receive a database download from the PC. The download shall restore data stored at the Controller to their normal working state and shall take place with no operator intervention.
  3. Software shall provide for setting downloads via dial-up connection to once per 24-hour period, with time selected by the operator.
  4. Software shall provide for setting delays of database downloads for dial-up connections. Delays change the download from immediately to a delay ranging from 1 to 999 minutes.
- K. Operator Interface:
1. Inputs in system shall have two icon representations, one for the normal state and one for the abnormal state.
  2. When viewing and controlling inputs, displayed icons shall automatically change to the proper icon to display the current system state in real time. Icons shall also display the input's state, whether armed or bypassed, and if the input is in the armed or bypassed state due to a time zone or a manual command.
  3. Outputs in system shall have two icon representations, one for the secure (locked) state and one for the open (unlocked) state.
  4. Icons displaying status of the I/O points shall be constantly updated to show their current real-time condition without prompting by the operator.
  5. The operator shall be able to scroll the list of I/Os and press the appropriate toolbar button, or right click, to command the system to perform the desired function.
  6. Graphic maps or drawings containing inputs, outputs, and override groups shall include the following:
    - a. Database to import and store full-color maps or drawings and allow for input, output, and override group icons to be placed on maps.
    - b. Maps to provide real-time display animation and allow for control of points assigned to them.

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- c. System to allow inputs, outputs, and override groups to be placed on different maps.
- d. Software to allow changing the order or priority in which maps will be displayed.
- 7. Override Groups Containing I/Os:
  - a. System shall incorporate override groups that provide the operator with the status and control over user-defined "sets" of I/Os with a single icon.
  - b. Icon shall change automatically to show the live summary status of points in that group.
  - c. Override group icon shall provide a method to manually control or set to time zone points in the group.
  - d. Override group icon shall allow the expanding of the group to show icons representing the live status for each point in the group, individual control over each point, and the ability to compress the individual icons back into one summary icon.
- 8. Schedule Overrides of I/Os and Override Groups:
  - a. To accommodate temporary schedule changes that do not fall within the holiday parameters, the operator shall have the ability to override schedules individually for each input, output, or override group.
  - b. Each schedule shall be composed of a minimum of two dates with separate times for each date.
  - c. The first time and date shall be assigned the override state that the point shall advance to, when the time and date become current.
  - d. The second time and date shall be assigned the state that the point shall return to, when the time and date become current.
- 9. Copy command in database shall allow for like data to be copied and then edited for specific requirements, to reduce redundant data entry.
- L. Operator Access Control:
  - 1. Control operator access to system controls through [three] password-protected operator levels. System operators and managers with appropriate password clearances shall be able to change operator levels for operators.
  - 2. Three successive attempts by an operator to execute functions beyond their defined level during a 24-hour period shall initiate a software tamper alarm.
  - 3. A minimum of [32] passwords shall be available with the system software. System shall display the operator's name or initials in the console's first field. System shall print the operator's name or initials, action, date, and time on the system printer at login and logoff.
  - 4. The password shall not be displayed or printed.
  - 5. Each password shall be definable and assignable for the following:
    - a. Commands usable.
    - b. Access to system software.
    - c. Access to application software.
    - d. Individual zones that are to be accessed.
    - e. Access to database.
- M. Operator Commands:
  - 1. Command Input: Plain-language words and acronyms shall allow operators to use the system without extensive training or data-processing backgrounds. System prompts shall be a word, a phrase, or an acronym.
  - 2. Command inputs shall be acknowledged and processing shall start in not less than [1] second(s).
  - 3. Tasks that are executed by operator's commands shall include the following:
    - a. Acknowledge Alarms: Used to acknowledge that the operator has observed the alarm message.
    - b. Place Zone in Access: Used to remotely disable intrusion alarm circuits emanating from a specific zone. System shall be structured so that console operator cannot disable tamper circuits.

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- c. Place Zone in Secure: Used to remotely activate intrusion alarm circuits emanating from a specific zone.
  - d. System Test: Allows the operator to initiate a system-wide operational test.
  - e. Zone Test: Allows the operator to initiate an operational test for a specific zone.
  - f. Print reports.
  - g. Change Operator: Used for changing operators.
  - h. Security Lighting Controls: Allows the operator to remotely turn on/off security lights.
  - i. Display Graphics: Used to display any graphic displays implemented in the system. Graphic displays shall be completed within 20 seconds from time of operator command.
  - j. Run system tests.
  - k. Generate and format reports.
  - l. Request help with the system operation.
    - 1) Include in main menus.
    - 2) Provide unique, descriptive, context-sensitive help for selections and functions with the press of one function key.
    - 3) Provide navigation to specific topic from within the first help window.
    - 4) Help shall be accessible outside the applications program.
  - m. Entry-Control Commands:
    - 1) Lock (secure) or unlock (open) each controlled entry and exit up to four times a day through time-zone programming.
    - 2) Arm or disarm each monitored input up to four times a day through time-zone programming.
    - 3) Enable or disable readers or keypads up to twice a day through time-zone programming.
    - 4) Enable or disable cards or codes up to four times per day per entry point through access-level programming.
4. Command Input Errors: Show operator input assistance when a command cannot be executed because of operator input errors. Assistance screen shall use plain-language words and phrases to explain why the command cannot be executed. Error responses that require an operator to look up a code in a manual or other document are not acceptable. Conditions causing operator assistance messages include the following:
- a. Command entered is incorrect or incomplete.
  - b. Operator is restricted from using that command.
  - c. Command addresses a point that is disabled or out of service.
  - d. Command addresses a point that does not exist.
  - e. Command is outside the system's capacity.
- N. Alarms:
- 1. System Setup:
    - a. Assign manual and automatic responses to incoming point status change or alarms.
    - b. Automatically respond to input with a link to other inputs, outputs, operator-response plans, unique sound with use of WAV files, and maps or images that graphically represent the point location.
    - c. 60-character message field for each alarm.
    - d. Operator-response-action messages shall allow message length of at least 65,000 characters, with database storage capacity of up to 32,000 messages. Setup shall assign messages to [access point] [zone] [sensor].
    - e. Secondary messages shall be assignable by the operator for printing to provide further information and shall be editable by the operator.
    - f. Allow 25 secondary messages with a field of 4 lines of 60 characters each.
    - g. Store the most recent 1000 alarms for recall by the operator using the report generator.

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2. Software Tamper:
    - a. Annunciate a tamper alarm when unauthorized changes to system database files are attempted. Three consecutive unsuccessful attempts to log onto system shall generate a software tamper alarm.
    - b. Annunciate a software tamper alarm when an operator or other individual makes three consecutive unsuccessful attempts to invoke functions beyond their authorization level.
    - c. Maintain a transcript file of the last 5000 commands entered at the each Central Station to serve as an audit trail. System shall not allow write access to system transcript files by any person, regardless of their authorization level.
    - d. Allow only acknowledgment of software tamper alarms.
  3. Read access to system transcript files shall be reserved for operators with the highest password authorization level available in system.
  4. Animated Response Graphics: Highlight alarms with flashing icons on graphic maps; display and constantly update the current status of alarm inputs and outputs in real time through animated icons.
  5. Multimedia Alarm Annunciation: WAV files to be associated with alarm events for audio annunciation or instructions.
  6. Alarm Handling: Each input may be configured so that an alarm cannot be cleared unless it has returned to normal, with options of requiring the operator to enter a comment about disposition of alarm. Allow operator to silence alarm sound when alarm is acknowledged.
  7. Alarm Automation Interface: High-level interface to Central Station alarm automation software systems. Allows input alarms to be passed to and handled by automation systems in same manner as burglar alarms, using an RS-232 ASCII interface.
  8. CCTV Alarm Interface: Allow commands to be sent to CCTV systems during alarms (or input change of state) through serial ports.
  9. Camera Control: Provides operator ability to select and control cameras from graphic maps.
- O. Alarm Monitoring: Monitor sensors, Controllers, and DTS circuits and notify operators of an alarm condition. Display higher-priority alarms first and, within alarm priorities, display the oldest unacknowledged alarm first. Operator acknowledgment of one alarm shall not be considered acknowledgment of other alarms nor shall it inhibit reporting of subsequent alarms.
1. Displayed alarm data shall include type of alarm, location of alarm, and secondary alarm messages.
  2. Printed alarm data shall include type of alarm, location of alarm, date and time (to nearest second) of occurrence, and operator responses.
  3. Maps shall automatically display the alarm condition for each input assigned to that map, if that option is selected for that input location.
  4. Alarms initiate a status of "pending" and require the following two handling steps by operators:
    - a. First Operator Step: "Acknowledged." This action shall silence sounds associated with the alarm. The alarm remains in the system "Acknowledged" but "Un-Resolved."
    - b. Second Operator Step: Operators enter the resolution or operator comment, giving the disposition of the alarm event. The alarm shall then clear.
  5. Each workstation shall display the total pending alarms and total unresolved alarms.
  6. Each alarm point shall be programmable to disallow the resolution of alarms until the alarm point has returned to its normal state.
  7. Alarms shall transmit to Central Station in real time, except for allowing connection time for dial-up locations.
  8. Alarms shall be displayed and managed from a minimum of four different windows.
    - a. Input Status Window: Overlay status icon with a large red blinking icon. Selecting the icon will acknowledge the alarm.

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- b. History Log Transaction Window: Display name, time, and date in red text. Selecting red text will acknowledge the alarm.
  - c. Alarm Log Transaction Window: Display name, time, and date in red. Selecting red text will acknowledge the alarm.
  - d. Graphic Map Display: Display a steady colored icon representing each alarm input location. Change icon to flashing red when the alarm occurs. Change icon from flashing red to steady red when the alarm is acknowledged.
9. Once an alarm is acknowledged, the operator shall be prompted to enter comments about the nature of the alarm and actions taken. Operator's comments may be manually entered or selected from a programmed predefined list, or a combination of both.
10. For locations where there are regular alarm occurrences, provide programmed comments. Selecting that comment shall clear the alarm.
11. The time and name of the operator who acknowledged and resolved the alarm shall be recorded in the database.
12. Identical alarms from same alarm point shall be acknowledged at same time the operator acknowledges the first alarm. Identical alarms shall be resolved when the first alarm is resolved.
13. Alarm functions shall have priority over downloading, retrieving, and updating database from workstations and Controllers.
14. When a reader-controlled output (relay) is opened, the corresponding alarm point shall be automatically bypassed.
- P. Monitor Display: Display text and graphic maps that include zone status integrated into the display. Colors are used for the various components and current data. Colors shall be uniform throughout the system.
- 1. Color Code:
    - a. FLASHING RED: Alerts operator that a zone has gone into an alarm or that primary power has failed.
    - b. STEADY RED: Alerts operator that a zone is in alarm and alarm has been acknowledged.
    - c. YELLOW: Advises operator that a zone is in access.
    - d. GREEN: Indicates that a zone is secure and that power is on.
  - 2. Graphics:
    - a. Support 32,000 graphic display maps and allow import of maps from a minimum of 16 standard formats from another drawing or graphics program.
    - b. Allow I/O to be placed on graphic maps by the drag-and-drop method.
    - c. Operators shall be able to view the inputs, outputs, and the point's name by moving the mouse cursor over the point on graphic map.
    - d. Inputs or outputs may be placed on multiple graphic maps. The operator shall be able to toggle to view graphic map associated with inputs or outputs.
    - e. Each graphic map shall have a display-order sequence number associated with it to provide a predetermined order when toggled to different views.
    - f. Camera icons shall have the ability to be placed on graphic maps that, when selected by an operator, will open a video window, display the camera associated with that icon, and provide pan-tilt-zoom control.
    - g. Input, output, or camera placed on a map shall allow the ability to arm or bypass an input, open or secure an output, or control the pan-tilt-zoom function of the selected camera.
- Q. System test software enables operators to initiate a test of the entire system or of a particular portion of the system.
- 1. Test Report: The results of each test shall be stored for future display or printout. The report shall document the operational status of system components.

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- R. Report Generator Software: Include commands to generate reports for displaying, printing, and storing on disk and tape. Reports shall be stored by type, date, and time. Report printing shall be the lowest priority activity. Report generation mode shall be operator selectable but set up initially as periodic, automatic, or on request. Include time and date printed and the name of operator generating the report. Report formats may be configured by operators.
1. Automatic Printing: Setup shall specify, modify, or inhibit the report to be generated; the time the initial report is to be generated; the time interval between reports; the end of period; and the default printer.
  2. Printing on Requests: An operator may request a printout of any report.
  3. Alarm Reports: Reporting shall be automatic as initially set up. Include alarms recorded by system over the selected time and information about the type of alarm [(such as door alarm, intrusion alarm, tamper alarm, etc.)], the type of sensor, the location, the time, and the action taken.
  4. Access and Secure Reports: Document zones placed in access, the time placed in access, and the time placed in secure mode.
  5. Custom Reports: Reports tailored to exact requirements of who, what, when, and where. As an option, custom report formats may be stored for future printing.
  6. Automatic History Reports: Named, saved, and scheduled for automatic generation.
  7. Cardholder Reports: Include data, or selected parts of the data, as well as the ability to be sorted by name, card number, imprinted number, or by any of the user-defined fields.
  8. Cardholder by Reader Reports: Based on who has access to a specific reader or group of readers by selecting the readers from a list.
  9. Cardholder by Access-Level Reports: Display everyone that has been assigned to the specified access level.
  10. Who Is In (Muster) Report:
    - a. Emergency Muster Report: One click operation on toolbar launches report.
    - b. Cardholder Report. Contain a count of persons that are "In" at a selected Location and a count with detailed listing of name, date, and time of last use, sorted by the last reader used or by the group assignment.
  11. Panel Labels Reports: Printout of control-panel field documentation including the actual location of equipment, programming parameters, and wiring identification. Maintain system installation data within system database so that they are available on-site at all times.
  12. Activity and Alarm On-Line Printing: Activity printers for use at workstations; prints all events or alarms only.
  13. History Reports: Custom reports that allows the operator to select any date, time, event type, device, output, input, operator, Location, name, or cardholder to be included or excluded from the report.
    - a. Initially store history on the hard disk of the host PC.
    - b. Permit viewing of the history on workstations or print history to any system printer.
    - c. The report shall be definable by a range of dates and times with the ability to have a daily start and stop time over a given date range.
    - d. Each report shall depict the date, time, event type, event description, device, or I/O name, cardholder group assignment, and cardholder name or code number.
    - e. Each line of a printed report shall be numbered to ensure that the integrity of the report has not been compromised.
    - f. Total number of lines of the report shall be given at the end of the report. If the report is run for a single event such as "Alarms," the total shall reflect how many alarms occurred during that period.
  14. Reports shall have the following four options:
    - a. View on screen.
    - b. Print to system printer. Include automatic print spooling and "Print To" options if more than one printer is connected to system.

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- c. "Save to File" with full path statement.
    - d. System shall have the ability to produce a report indicating status of system inputs and outputs or of inputs and outputs that are abnormal, out of time zone, manually overridden, not reporting, or in alarm.
  15. Custom Code List Subroutine: Allow the access codes of system to be sorted and printed according to the following criteria:
    - a. Active, inactive, or future activate or deactivate.
    - b. Code number, name, or imprinted card number.
    - c. Group, Location, access levels.
    - d. Start and stop code range.
    - e. Codes that have not been used since a selectable number of days.
    - f. In, out, or either status.
    - g. Codes with trace designation.
  16. The reports of system database shall allow options so that every data field may be printed.
  17. The reports of system database shall be constructed so that the actual position of the printed data shall closely match the position of the data on the data-entry windows.
- S. Anti-Passback:
  1. System shall have global and local anti-passback features, selectable by Location. System shall support hard and soft anti-passback.
  2. Hard Anti-Passback: Once a credential holder is granted access through a reader with one type of designation (IN or OUT), the credential holder may not pass through that type of reader designation until the credential holder passes through a reader of opposite designation.
  3. Soft Anti-Passback: Should a violation of the proper IN or OUT sequence occur, access shall be granted, but a unique alarm shall be transmitted to the control station, reporting the credential holder and the door involved in the violation. A separate report may be run on this event.
  4. Timed Anti-Passback: A Controller capability that prevents an access code from being used twice at the same device (door) within a user-defined amount of time.
  5. Provide four separate zones per Location that can operate without requiring interaction with the host PC (done at Controller). Each reader shall be assignable to one or all four anti-passback zones. In addition, each anti-passback reader can be further designated as "Hard," "Soft," or "Timed" in each of the four anti-passback zones. The four anti-passback zones shall operate independently.
  6. The anti-passback schemes shall be definable for each individual door.
  7. The Master Access Level shall override anti-passback.
  8. System shall have the ability to forgive (or reset) an individual credential holder or the entire credential holder population anti-passback status to a neutral status.
- T. Visitor Assignment:
  1. Provide for and allow an operator to be restricted to only working with visitors. The visitor badging subsystem shall assign credentials and enroll visitors. Allow only access levels that have been designated as approved for visitors.
  2. Provide an automated log of visitor name, time and doors accessed, and whom visitor contacted.
  3. Allow a visitor designation to be assigned to a credential holder.
  4. PACS shall be able to restrict the access levels that may be assigned to credentials that are issued to visitors.
  5. Allow operator to recall visitors' credential holder file, once a visitor is enrolled in the system.
  6. The operator may designate any reader as one that deactivates the credential after use at that reader. The history log shall show the return of the credential.

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7. System shall have the ability to use the visitor designation in searches and reports. Reports shall be able to print all or any visitor activity.
- U. Time and Attendance:
1. Time and attendance reporting shall be provided to match IN and OUT reads and display cumulative time in for each day and cumulative time in for length of the report.
  2. Shall be provided to match IN and OUT reads and display cumulative time in for each day and cumulative time in for length of the report.
  3. System software setup shall allow designation of selected access-control readers as time and attendance hardware to gather the clock-in and clock-out times of the users at these readers.
    - a. Reports shall show in and out times for each day, total in time for each day, and a total in time for period specified by the user.
    - b. Allow the operator to view and print the reports, or save the report to a file.
    - c. Alphabetically sort reports on the person's last name, by Location or location group. Include all credential holders or optionally select individual credential holders for the report.
- V. Training Software: Enables operators to practice system operation including alarm acknowledgment, alarm assessment, response force deployment, and response force communications. System shall continue normal operation during training exercises and shall terminate exercises when an alarm signal is received at the console.
- W. Entry-Control Enrollment Software: Database management functions that allow operators to add, delete, and modify access data as needed.
1. The enrollment station shall not have alarm response or acknowledgment functions.
  2. Provide multiple, password-protected access levels. Database management and modification functions shall require a higher operator access level than personnel enrollment functions.
  3. The program shall provide means to disable the enrollment station when it is unattended to prevent unauthorized use.
  4. The program shall provide a method to enter personnel identifying information into the entry-control database files through enrollment stations. In the case of personnel identity verification subsystems, this shall include biometric data. Allow entry of personnel identifying information into the system database using menu selections and data fields. The data field names shall be customized during setup to suit user and site needs. Personnel identity verification subsystems selected for use with the system shall fully support the enrollment function and shall be compatible with the entry-control database files.
  5. Cardholder Data: Provide 99 user-defined fields. System shall have the ability to run searches and reports using any combination of these fields. Each user-defined field shall be configurable, using any combination of the following features:
    - a. MASK: Determines a specific format that data must comply with.
    - b. REQUIRED: Operator is required to enter data into field before saving.
    - c. UNIQUE: Data entered must be unique.
    - d. DEACTIVATE DATE: Data entered will be evaluated as an additional deactivate date for all cards assigned to this cardholder.
    - e. NAME ID: Data entered will be considered a unique ID for the cardholder.
  6. Personnel Search Engine: A report generator with capabilities such as search by last name, first name, group, or any predetermined user-defined data field; by codes not used in definable number of days; by skills; or by seven other methods.
  7. Multiple Deactivate Dates for Cards: User-defined fields to be configured as additional stop dates to deactivate any cards assigned to the cardholder.
  8. Batch card printing.



9. Default card data can be programmed to speed data entry for sites where most card data are similar.
  10. Enhanced ACSII File Import Utility: Allows the importing of cardholder data and images.
  11. Card Expire Function: Allows readers to be configured to deactivate cards when a card is used at selected devices.
- X. System Redundancy & High Availability: The system shall provide multiple levels of communications redundancy and failover for all PACS hosted controllers, digital video recorders, and client workstations. The PACS shall be capable of automatically re-routing communications to alternate computers across the system without operator intervention.
1. PACS system configuration with a single application/ database server shall provide at a minimum the following redundancy and failover capability:
    - a. The PACS shall provide communications redundancy and failover for network-attached devices. Each network attached device shall have one or more alternative communication sever(s) that can provide hosting in case of primary communications server failure.
    - b. In case of primary communications server failure, the system shall automatically re-route network-attached devices to their designated backup communications servers to allow continuous system operations without loss of alarm and event transaction processing during failover.
    - c. Network-attached devices which transition to backup communications servers, shall be able to be redirected back to their default primary servers, once the primary communications servers have been restored.
  2. PACS system configuration with multiple regional application/ database servers shall provide at a minimum the following redundancy and failover capability:
    - a. The PACS shall support the same level of communications redundancy and failover for network-attached devices per regional application/database server, allowable to span across regional application/database servers in the event of a regional application/database server failure.
    - b. In case of a regional application/database server failure, client workstations shall be able to failover to their designated backup regional application/database server to allow continuous system operations.
    - c. In case of a regional application/database server failure, upon server restoration, the ISMS shall automatically update and synchronize the regional application/database server.
    - d. Client workstations which transition to a backup regional application/database server, shall be able to be redirected back to their default regional application/database server, once the regional application/database server functions have been restored.

#### **2.04 SURGE AND TAMPER PROTECTION**

- A. Refer to 28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY
- B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor-entry connection to components.
  1. Minimum Protection for Power Connections 120 V and More: Auxiliary panel suppressors complying with requirements in Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits."
  2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Connections: Comply with requirements in Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits" as recommended by manufacturer for type of line being protected.
- C. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station control-unit alarm display shall identify

tamper alarms and indicate locations.

## 2.05 PACS SERVER HARDWARE

- A. SMS Server Computer: Standard unmodified PC of modular design. The CPU word size shall be 64 bytes or larger; the CPU operating speed shall be at least 3.4 GHz.
1. Processor family: [Intel® Xeon® E5640 (4 core, 2.66 GHz, 12MB L3, 80W)] .
  2. Number of processors: 2
  3. Memory: [12] GB RAM , expandable to a minimum of [192] GB without additional chassis or power supplies. Memory protection [Mirrored Memory, Online Spare, Advanced ECC, Memory Lock Step Mode] .
  4. Input/Output: 2 expansions slots, Network Controller (2) 1GbE NC382i Multifunction 4 Ports.
  5. Power Supply: Dual - minimum capacity of [460] W hot plug.
  6. Real-Time Clock:
    - a. Accuracy: Plus or minus 1 minute per month.
    - b. Time Keeping Format: 24-hour time format including seconds, minutes, hours, date, day, and month; resettable by software.
    - c. Clock shall function for 1 year without power.
    - d. Provide automatic time correction once every 24 hours by synchronizing clock with the Time Service Department of the U.S. Naval Observatory.
  7. Serial Ports: Provide two RS-232-F serial ports for general use, with additional ports as required. Data transmission rates shall be selectable under program control.
  8. Parallel Port: An enhanced parallel port.
  9. The server shall have a 1 GB NIC or greater network card, rated at 100/1000 MB/sec.
  10. The server shall have dual 100 GB hard disk drives at 7200 RPM.
  11. The server shall have a CD / DVD combo drive.
  12. The server operating system shall be either:
    - a. Windows 2003 Server, 32 bit native mode, with Service Pack 2 or later with default services enabled.
    - b. Windows XP Professional Service Pack 2 or later and default services enabled.
    - c. Windows 2008.
  13. The Web Server shall be [IIS 7.0] or better.
  14. The Database shall be SQL Server 2005 (Express, Standard, Data Center, or Enterprise)].
  15. Sound Card: For playback and recording of digital WAV sound files that are associated with audible warning and alarm functions.
  16. Color Monitor: 17-inches or larger SVGA (1024 x 768) monitor with true color support.. The server shall have a dedicated 256 MB SVGA accelerated video card with at least 64 MB onboard RAM.
  17. Keyboard: With a minimum of 64 characters, standard ASCII character set based on ANSI X3.154.
  18. Mouse: Standard, compatible with the installed software.
  19. Special function keyboard attachments or special function keys to facilitate data input of the following operator tasks:
    - a. Help.
    - b. Alarm Acknowledge.
    - c. Place Zone in Access.
    - d. Place Zone in Secure.
    - e. System Test.
    - f. Print Reports.
    - g. Change Operator.
  20. CD-ROM Drive:
    - a. Nominal storage capacity of [650] MB.
    - b. Data Transfer Rate: [1.2] Mbps.

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- c. Average Access Time: [150] ms.
- d. Cache Memory: [256] KB.
- e. Data Throughput: [1] MB/second, minimum.
- 21. Dot Matrix Alarm Printer:
  - a. Connected to the Central Station.
  - b. Minimum of 96 characters, standard ASCII character set based on ANSI X3.154, and with graphics capability and programmable control of top-of-form.
  - c. Prints in both red and black without ribbon change.
  - d. Adjustable sprockets for paper width up to 11 inches.
  - e. 80 columns per line, minimum speed of 200 characters per second.
  - f. Character Spacing: Selectable at 10, 12, or 17 characters per inch.
  - g. Paper: Sprocket-fed fan fold paper.
- 22. Report Printer:
  - a. Connected to the Central Station and designated workstations.
  - b. Laser printer with minimum resolution of [1200] dpi.
  - c. RAM: [2] MB, minimum.
  - d. Printing Speed: Minimum [12] pages per minute.
  - e. Paper Handling: Automatic sheet feeder with [250] -sheet paper cassette and with automatic feed.
  - f. Interface: Bidirectional parallel and universal serial bus.
- B. Redundant Central Computer: One identical redundant central computer, connected in a hot standby, peer configuration. This computer shall automatically maintain its own copies of system software, application software, and data files. System transactions and other activities that alter system data files shall be updated to system files of redundant computer in near real-time. If central computer fails, redundant computer shall assume control immediately and automatically.
- C. PACS controllers clustering shall support the following features:
  - 1. Assignment of Master and alternate master controllers for cluster communication to the SMS server
  - 2. Primary and backup communication paths to the SMS server
  - 3. Encrypted communications
  - 4. Up to [16] controllers per cluster
  - 5. Logical event linking between controllers in a cluster independent of SMS server communication
  - 6. Asynchronous communication via TCP/IP (Polled devices shall not be acceptable)
- D. UPS: Self-contained; complying with requirements in Division 26 Section "Static Uninterruptible Power Supply."
  - 1. Size: Provide a minimum of [15] hours of operation of the central-station equipment, including 2 hours of alarm printer operation.
  - 2. Batteries: Sealed, valve regulated, recombinant, lead calcium.
  - 3. Accessories:
    - a. Transient voltage suppression.
    - b. Input-harmonics reduction.
    - c. Rectifier/charger.
    - d. Battery disconnect device.
    - e. Static bypass transfer switch.
    - f. Internal maintenance bypass/isolation switch.
    - g. External maintenance bypass/isolation switch.
    - h. Output isolation transformer.
    - i. Remote UPS monitoring.
    - j. Battery monitoring.

- k. Remote battery monitoring.

## 2.06 STANDARD WORKSTATION HARDWARE

- A. Workstation shall consist of a standard unmodified PC, with accessories and peripherals that configure the workstation for a specific duty.
- B. Workstation Computer: Standard unmodified PC of modular design. The CPU word size shall be [32] bytes or larger; the CPU operating speed shall be at least [66] [MHz] [GHz].
1. Memory: [256] MB of usable installed memory, expandable to a minimum of [1024] MB without additional chassis or power supplies.
  2. Power Supply: Minimum capacity of [250] W.
  3. Real-Time Clock:
    - a. Accuracy: Plus or minus 1 minute per month.
    - b. Time Keeping Format: 24-hour time format including seconds, minutes, hours, date, day, and month; resettable by software.
    - c. Provide automatic time correction once every [24 hours] by synchronizing clock with the Central Station.
  4. Serial Ports: Provide two RS-232-F serial ports for general use, with additional ports as required. Data transmission rates shall be selectable under program control.
  5. Parallel Port: An enhanced parallel port.
  6. LAN Adapter Card: [10/100] Mbps PCI bus, internal network interface card.
  7. Sound Card: For playback and recording of digital WAV sound files that are associated with audible warning and alarm functions.
  8. Color Monitor: Not less than [17 inches (430 mm)] , with a minimum resolution of [1280 by 1024] pixels, noninterlaced, and a maximum dot pitch of [0.28] mm. The video card shall support at least [256] colors at a resolution of [1280 by 1024] at a minimum refresh rate of [70] Hz.
  9. Keyboard: With a minimum of 64 characters, standard ASCII character set based on ANSI X3.154.
  10. Mouse: Standard, compatible with the installed software.
  11. Disk storage shall include the following, each with appropriate controller:
    - a. Minimum [10] GB hard disk, maximum average access time of [10] ms.
    - b. Floppy Disk Drive: High density, 3-1/2-inch (90-mm) size.
  12. CD-ROM Drive:
    - a. Nominal storage capacity of [650] MB.
    - b. Data Transfer Rate: [1.2] Mbps.
    - c. Average Access Time: [150] ms.
    - d. Cache Memory: [256] KB.
    - e. Data Throughput: [1] MB/second, minimum.
  13. Printer:
    - a. Connected to the Central Station and designated workstations.
    - b. Laser printer with minimum resolution of [600] dpi.
    - c. RAM: [2] MB, minimum.
    - d. Printing Speed: Minimum [12] pages per minute.
    - e. Paper Handling: Automatic sheet feeder with [250] -sheet paper cassette and with automatic feed.
  14. Interface: Bidirectional parallel, and universal serial bus.
  15. LAN Adapter Card: [10/100] Mbps internal network interface card.
- C. Redundant Workstation: One identical redundant workstation, connected in a hot standby, peer configuration. This workstation shall automatically maintain its own copies of system software, application software, and data files. System transactions and other activities that alter system data files shall be updated to system files of redundant workstation in near real time. If its associated workstation fails, redundant workstation shall assume control immediately and

automatically.

- D. UPS: Self-contained, complying with requirements in Division 26 Section "Static Uninterruptible Power Supply."
  - 1. Size: Provide a minimum of [6] hours of operation of the central-station equipment, including 2 hours of alarm printer operation.
  - 2. Batteries: Sealed, valve regulated, recombinant, lead calcium.
  - 3. Accessories:
    - a. Transient voltage suppression.
    - b. Input-harmonics reduction.
    - c. Rectifier/charger.
    - d. Battery disconnect device.
    - e. Static bypass transfer switch.
    - f. Internal maintenance bypass/isolation switch.
    - g. External maintenance bypass/isolation switch.
    - h. Output isolation transformer.
    - i. Remote UPS monitoring.
    - j. Battery monitoring.
    - k. Remote battery monitoring.

## 2.07 COMMUNICATIONS WORKSTATION

- A. Standard workstation, modified as follows:
  - 1. Additional RS-232-F serial ports. The CPU word size shall be [32] bytes or larger; the CPU operating speed shall be at least [66] MHz. Multiplexed serial ports shall be expandable with [8] character transmit and receive buffers for each port. Total buffer size shall be a minimum of [1] MB.
- B. Redundant workstation is required.
- C. Printer is not required.

## 2.08 CONTROLLERS

- A. Controllers: Intelligent peripheral control unit, complying with UL 294, that stores time, date, valid codes, access levels, and similar data downloaded from the Central Station or workstation for controlling its operation.
- B. Subject to compliance with requirements in this Article, manufacturers may use multipurpose Controllers.
- C. Battery Backup: Sealed, lead acid; sized to provide run time during a power outage of 90 minutes, complying with UL 924.
- D. Alarm Annunciation Controller.
  - 1. The Controller shall automatically restore communication within 10 seconds after an interruption with the field device network with dc line supervision on each of its alarm inputs.
    - a. Inputs: Monitor dry contacts for changes of state that reflect alarm conditions. Provides at least eight alarm inputs, which are suitable for wiring as normally open or normally closed contacts for alarm conditions.
    - b. Alarm-Line Supervision:
      - 1) Supervise the alarm lines by monitoring each circuit for changes or disturbances in the signal[, and for conditions as described in UL 1076 for line security equipment] [by monitoring for abnormal open, grounded, or shorted conditions] using dc change measurements. System shall initiate an alarm in response to an abnormal current, which is a dc change of [5] [10] percent or more for longer than 500 ms.
      - 2) Transmit alarm-line-supervision alarm to the Central Station during the next interrogation cycle after the abnormal current condition.

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- c. Outputs: Managed by Central Station software.
- 2. Auxiliary Equipment Power: A GFI service outlet inside the Controller enclosure.
- E. Entry-Control Controller:
  - 1. Function: Provide local entry-control functions including one- and two-way communications with access-control devices such as card readers, keypads, biometric personal identity verification devices, door strikes, magnetic latches, gate and door operators, and exit push-buttons.
    - a. Operate as a stand-alone portal Controller using the downloaded database during periods of communication loss between the Controller and the field-device network.
    - b. Accept information generated by the entry-control devices; automatically process this information to determine valid identification of the individual present at the portal:
      - 1) On authentication of the credentials or information presented, check privileges of the identified individual, allowing only those actions granted as privileges.
      - 2) Privileges shall include, but not be limited to, time of day control, day of week control, group control, and visitor escort control.
    - c. Maintain a date-, time-, and Location-stamped record of each transaction. A transaction is defined as any successful or unsuccessful attempt to gain access through a controlled portal by the presentation of credentials or other identifying information.
  - 2. Inputs:
    - a. Data from entry-control devices; use this input to change modes between access and secure.
    - b. Database downloads and updates from the Central Station that include enrollment and privilege information.
  - 3. Outputs:
    - a. Indicate success or failure of attempts to use entry-control devices and make comparisons of presented information with stored identification information.
    - b. Grant or deny entry by sending control signals to portal-control devices[ and mask intrusion alarm annunciation from sensors stimulated by authorized entries].
    - c. Maintain a date-, time-, and Location-stamped record of each transaction and transmit transaction records to the Central Station.
    - d. Door Prop Alarm: If a portal is held open for longer than [20 seconds] [time listed in a schedule], alarm sounds.
  - 4. With power supplies sufficient to power at voltage and frequency required for field devices and portal-control devices.
  - 5. Data Line Problems: For periods of loss of communications with Central Station, or when data transmission is degraded and generating continuous checksum errors, the Controller shall continue to control entry by accepting identifying information, making authentication decisions, checking privileges, and controlling portal-control devices.
    - a. Store up to [1000] transactions during periods of communication loss between the Controller and access-control devices for subsequent upload to the Central Station on restoration of communication.
  - 6. Controller Power: NFPA 70, Class II power supply transformer, with 12- or 24-V ac secondary, backup battery and charger.
    - a. Backup Battery: Premium, valve-regulated, recombinant-sealed, lead-calcium battery; spill proof; with a full 1-year warranty and a pro rata 19-year warranty. With single-stage, constant-voltage-current, limited battery charger, comply with battery manufacturer's written instructions for battery terminal voltage and charging current recommendations for maximum battery life.
    - b. Backup Battery: Valve-regulated, recombinant-sealed, lead-acid battery; spill proof. With single-stage, constant-voltage-current, limited battery charger, comply with battery manufacturer's written instructions for battery terminal voltage and charging current recommendations for maximum battery life.

- c. Backup Power Supply Capacity: [5] [90] minutes of battery supply. Submit battery and charger calculations.
- d. Power Monitoring: Provide manual dynamic battery load test, initiated and monitored at the control center; with automatic disconnection of the Controller when battery voltage drops below Controller limits. Report by using local Controller-mounted LEDs and by communicating status to Central Station. Indicate normal power on and battery charger on trickle charge. Indicate and report the following:
  - 1) Trouble Alarm: Normal power off load assumed by battery.
  - 2) Trouble Alarm: Low battery.
  - 3) Alarm: Power off.

## 2.09 PIV MIDDLEWARE

- A. PIV Middleware shall provide three-factor authentication, including biometric matching using a fingerprint capture device capable of single fingerprint capture. Unit shall enable digital certificates can be verified by security personnel using the issuer's certificate authority, SCVP, OSCP responder/repeater, or the TSA hot list for TWIC cardholders. All cards shall be validated using FIPS-201 challenge-response protocol in order to identify forged or cloned cards. PIV Middleware solution shall validate all PIV, TWIC, NG CAC, and FRAC cards. TWIC card FASC-Ns shall also be verified against a live or cached TSA hot list.
- B. PIV Middleware shall have ability to:
  - 1. Verify cardholder identity and validates FIPS 201-compliant PIV-II, next-generation (NG) CAC, TWIC, or FRAC credentials in real-time
  - 2. Perform three-factor authentication of cardholder using PIN, biometrics, and certificate (or serial numbers) detecting forged or cloned cards
  - 3. Enroll FASC-N, photo, and pertinent cardholder information into PACS software
  - 4. Automatically suspend a cardholder's badge if his or her PIV, TWIC, or CAC card certificate serial number is on the Certificate Revocation List (CRL)
  - 5. Upload a cardholder transaction audit trail to central database or exports it to a .csv file for centralized transaction management
  - 6. Be compatible with biometric mobile terminal for off-site verification and enrollment
  - 7. Re-validate imported cardholder certificates on a periodic basis via the Internet
  - 8. Operate with commercial, off-the-shelf (COTS) FIPS 201 PIV-II and ANSI INCITS 378-compliant fingerprint capture devices
  - 9. Revalidate imported cardholder certificates at regular intervals, ensuring that the credentials used in PACS system are backed by a valid set of digital certificates. Digital certificates are verified against local OSCP repeater/validation authority using the issuer's validation authority, or Microsoft Crypto Application Programming Interface (API) on Windows XP SP3 or Vista.
  - 10. Certificate Manager shall fully support SCVP and OSCP for fast, online validation.
  - 11. Provide verification of TWIC credentials against a live TSA hot list.
  - 12. Support uploading local transactions to a central database for consolidated activity reporting. This application shall support a variety of ODBC- or ADO-compliant databases, including Oracle, SQL Server 2005, Informix, DB2, and Firebird.
  - 13. Provide user with ability to produce canned transaction log queries as well as creating queries directly from the SQL database.
- C. PIV Middleware PC requirements:
  - 1. PIV Middleware software shall operate on Intel-based PC with minimum 1.8 GHz CPU, 1 GB RAM, 40 GB hard disk, and Microsoft Windows XP SP2 with Microsoft .NET Framework 2.0
  - 2. Unit shall fingerprint capture devices and smart card reader.
- D. PIV Middleware shall be FIPS 201 approved product.

## 2.10 CARD READERS

- A. Power: Card reader shall be powered from its associated Controller, including its standby power source.
- B. Response Time: Card reader shall respond to passage requests by generating a signal that is sent to the Controller. Response time shall be [800]ms or less, from the time the card reader finishes reading the credential card until a response signal is generated.
- C. Enclosure: Suitable for surface, semiflush, or pedestal mounting. Mounting types shall additionally be suitable for installation in the following locations:
  - 1. Indoors, controlled environment.
  - 2. Indoors, uncontrolled environment.
  - 3. Outdoors, with built-in heaters or other cold-weather equipment to extend the operating temperature range as needed for operation at the site.
- D. Display: LED or other type of visual indicator display shall provide visual[ and audible] status indications and user prompts. Indicate power on/off, whether user passage requests have been accepted or rejected, and whether the door is locked or unlocked.
- E. Shall be utilized for controlling the locking hardware on a door and allows for reporting back to the main control panel with the time/date the door was accessed, the name of the person accessing the point of entry, and its location.
- F. Will be fully programmable and addressable, locally and remotely, and hardwired to the system.
- G. Shall be individually home run to the main panel.
- H. Shall be installed in a manner that they comply with:
  - 1. The Uniform Federal Accessibility Standards (UFAS)
  - 2. The Americans with Disabilities Act (ADA)
  - 3. The ADA Standards for Accessible Design
- I. Shall support a variety of card readers that must encompass a wide functional range. The PACS may combine any of the card readers described below for installations requiring multiple types of card reader capability (i.e., card only, card and/or PIN, card and/or biometrics, card and/or pin and/or biometrics, supervised inputs, etc.). These card readers shall be available in the approved technology to meet FIPS 201, and is ISO 14443 A or B, ISO/IEC 7816 compliant. The reader output can be Wiegand, RS-22, 485 or TCP/IP.
- J. Shall be housed in an aluminum bezel with a wide lead-in for easy card entry.
- K. Shall contain read head electronics, and a sender to encode digital door control signals.
- L. LED's shall be utilized to indicate card reader status and access status.
- M. Shall be able to support a user defined downloadable off-line mode of operation (e.g. locked, unlocked), which will go in effect during loss of communication with the main control panel.
- N. Shall provide audible feedback to indicate access granted/denied decisions. Upon a card swipe, two audible tones or beeps shall indicate access granted and three tones or beeps shall indicate access denied. All keypad buttons shall provide tactile audible feedback.
- O. Shall have a minimum of two programmable inputs and two programmable outputs.
- P. All card readers that utilize keypad controls along with a reader and shall meet the following specifications:
  - 1. Entry control keypads shall use a unique combination of alphanumeric and other symbols as an identifier. Keypads shall contain an integral alphanumeric/special symbols keyboard with symbols arranged in ascending ASCII code ordinal sequence. Communications protocol shall be compatible with the local processor.
- Q. Shall include a Light Emitting Diode (LED) or other type of visual indicator display and provide visual or visual and audible status indications and user prompts. The display shall indicate power on/off, and whether user passage requests have been accepted or rejected. The design



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of the keypad display or keypad enclosure shall limit the maximum horizontal and vertical viewing angles of the keypad. The maximum horizontal viewing angle shall be plus and minus five (5) degrees or less off a vertical plane perpendicular to the plane of the face of the keypad display. The maximum vertical viewing angle shall be plus and minus 15 degrees or less off a horizontal plane perpendicular to the plane of the face of the keypad display.

1. Shall respond to passage requests by generating a signal to the local processor. The response time shall be 800 milliseconds or less from the time the last alphanumeric symbol is entered until a response signal is generated.
2. Shall be powered from the source as designed and shall not dissipate more than 150 Watts.
3. Shall be suitable for surface, semi-flush, pedestal, or weatherproof mounting as required.
4. Shall provide a means for users to indicate a duress situation by entering a special code.

R. PIV Contact Card Reader

1. Application Protocol Data Unit (APDU) Support: At a minimum, the contact interface shall support all card commands for contact based access specified in Section 7, End-point PIV Card Application Card Command Interface of SP 800-73-1, Interfaces for Personal Identity Verification.
2. Buffer Size: The reader must contain a buffer large enough to receive the maximum size frame permitted by International Organization for Standardization International Electrotechnical Commission (ISO/IEC) 7816-3:1997, Section 9.4.
3. Programming Voltage: PIV Readers shall not generate a Programming Voltage.
4. Support for Operating Class: PIV Readers shall support cards with Class A Vccs as defined in ISO/IEC 7816-3:1997 and ISO/IEC 7816-3:1997/Amd 1:2002.
5. Retrieval Time: Retrieval time for 12.5 kilobytes (KB) of data through the contact interface of the reader shall not exceed 2.0 seconds.
6. Transmission Protocol: The PIV Reader shall support both the character-based T=0 protocol and block-based T=1 protocol as defined in ISO/IEC 7816-3:1997.
7. Support for PPS Procedure: The reader shall support Protocol and Parameters Selection (PPS) procedure by having the ability to read character TA1 of the Answer to Reset (ATR) sent by the card as defined in ISO/IEC 7816-3:1997.

S. Contactless Smart Cards and Readers

1. Smart card readers shall read credential cards whose characteristics of size and technology meet those defined by ISO/IEC 7816, 14443, 15693.
2. The readers shall have "flash" download capability to accommodate card format changes.
3. The card reader shall have the capability of reading the card data and transmitting the data to the main monitoring panel.
4. The card reader shall be contactless and meet or exceed the following technical characteristics:
  - a. Data Output Formats: FIPS 201 low outputs the FASC-N in an assortment of Wiegand bit formats from 40 – 200 bits. FIPS 201 medium outputs a combination FASC-N and HMAC in an assortment of Wiegand bit formats from 32 – 232 bits. All Wiegand formats or the upgradeability from Low to Medium Levels can be field configured with the use of a command card.
  - b. FIPS 201 readers shall be able to read, but not be limited to, DESfire and iCLASS cards.
  - c. Reader range shall comply with ISO standards 7816, 14443, and 15693, and also take into consideration conditions, are at a minimum 1" to 2" (2.5 – 5 cm).
  - d. APDU Support: At a minimum, the contactless interface shall support all card commands for contactless based access specified in Section 7, End-point PIV Card Application Card Command Interface of SP 800-73-1, Interfaces for Personal Identity Verification.
  - e. Buffer Size: The reader shall contain a buffer large enough to receive the maximum size frame permitted by ISO/IEC 7816-3, Section 9.4.

- f. ISO 14443 Support: The PIV Reader shall support parts (1 through 4) of ISO/IEC 14443 as amended in the References of this publication.
- g. Type A and B Communication Signal Interfaces: The contactless interface of the reader shall support both the Type A and Type B communication signal interfaces as defined in ISO/IEC 14443-2:2001.
- h. Type A and B Initialization and Anti-Collision The contactless interface of the reader shall support both Type A and Type B initialization and anti-collision methods as defined in ISO/IEC 14443-3:2001.
- i. Type A and B Transmission Protocols: The contactless interface of the reader shall support both Type A and Type B transmission protocols as defined in ISO/IEC 14443-4:2001.
- j. Retrieval Time: Retrieval time for 4 KB of data through the contactless interface of the reader shall not exceed 2.0 seconds.
- k. Transmission Speeds: The contactless interface of the reader shall support bit rates of fc/128 (~106 kbits/s), fc/64(~212 kbits/s), and configurable to allow activation/deactivation.
- l. Readability Range: The reader shall not be able to read PIV card more than 10cm(4inch) from the reader

#### **2.11 BIOMETRIC IDENTITY VERIFICATION EQUIPMENT**

- A. Shall be FIPS 201 and NIST SP 800-76 compliant.
- B. Shall utilize hand/palm, fingerprint, retinal, facial image, or voice verification and could be utilized as secondary authentication in conjunction with card readers in high security area as defined by the VA. (Note: VA policy requires that the use of biometric measurements is limited to secondary authentication in high or medium security applications).
- C. Shall be programmable, addressable, and hardwired directly to the main control panel and individually home run to the main control panel.
- D. Shall be installed in a manner that they comply with:
  - 1. The Uniform Federal Accessibility Standards (UFAS)
  - 2. The Americans with Disabilities Act (ADA)
  - 3. The ADA Standards for Accessible Design
- E. Shall include a means to construct individual templates or profiles based upon measurements taken from the person to be enrolled. This template shall be stored as part of the System Reference Database Files. The stored template shall be used as a comparative base by the personnel identity verification equipment to generate appropriate signals to the associated local processors.
- F. Shall interface with PACS and SMS and provide the employee's name, contact information, and point of access.
- G. Shall allow for surface, flush, or pedestal mounting.
- H. Shall have communications protocol in place that shall allow for communications with the SMS.
- I. Shall determine when multiple attempts were made for verification, and shall automatically prompt the user for additional attempts up to a maximum of three tries. After a third failed attempt the unit shall generate an entry control alarm. This alarm will report to the SMS and the CCTV system. The camera viewpoint for where the alarm was generated shall automatically be called up onto a monitor and be recorded via the recording equipment. An alarm within the SMS shall also be generated recording, at a minimum, the date, time, and attempted point of entry.
- J. Hand/Palm Geometry Verification:
  - 1. Shall utilize unique human hand measurements to identify authorized, enrolled personnel.
  - 2. During the scan process the hand geometry device, which shall allow the user's hand to remain in full view during the scanning process, shall a three (3) dimensional

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- measurement of the user's hand identifying its size and shape.
3. This scan process shall start automatically once the user's hand is positioned. The hand geometry device shall be able to use either left or right hands for enrollment and verification.
  4. Shall include an LED or other type of visual indicator display and provide visual or visual and audible status indications and user prompts. The display shall indicate power on/off, and whether user passage requests have been accepted or rejected.
  5. Shall only be updated at the unit itself and automatic updates via the SMS shall not be allowed.
  6. Any significant change to the user's hand, scars, loss of digit, or any other change that will alter the three dimension view of the hand shall require an update to the unit and SMS.
  7. Shall provide an enrollment, recognition, and code/credential verification mode. The enrollment mode shall create a hand template for new personnel and enter the template into the entry control database file created for that person. Template information shall be compatible with the system application software. The operating mode shall be selectable by the system manager/operator from the central processor. When operating in recognition mode, the hand geometry device shall allow passage when the hand scan data from the verification attempt matches a hand geometry template stored in the database files. When operating in code/credential verification mode, the hand geometry device shall allow passage when the hand scan data from the verification attempt matches the hand geometry template associated with the identification code entered into a keypad; or matches the hand geometry template associated with credential card data read by a card reader.
- K. Fingerprint Verification:
1. Shall use a unique human fingerprint pattern to identify authorized, enrolled personnel.
  2. Shall allow the user's hand to remain in full view during the scanning process, shall incorporate positive measures to establish that the hand or fingers being scanned by the device belong to a living human being.
  3. Shall provide an optical or other type of scan of the user's fingers. The fingerprint verification scanner shall automatically initiate the scan process provided the user's fingers are positioned.
  4. LED or other type of visual indicator displays shall provide a visual or visual and audible status indication and enrollee prompts. The display shall indicate power on/off, and whether user passage requests have been accepted or rejected.
  5. Any significant change to the user's finger such as scars, loss of digit, or any other change that will alter the finger print shall require an update to the unit and SMS.
  6. Shall provide an adjustable acceptance tolerance or template match criteria under system manager/operator control.
  7. Shall respond to passage requests by generating signals to the local processor. The verification time shall be 2.0 seconds or less from the moment the finger print analysis scanner initiates the scan process until the fingerprint analysis scanner generates a response signal.
  8. Shall:
    - a. Provide an enrollment mode, recognition mode, and code/credential verification mode. The enrollment mode shall create a fingerprint template for new personnel and enter the template into the system database file created for that person.
    - b. Template information shall be compatible with the system application software.
    - c. The operating mode shall be selectable by the system manager/operator from the central station.
  9. When operating in recognition mode, the fingerprint analysis scanner shall allow passage when the fingerprint data from the verification attempt matches a fingerprint template stored in the database files.

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10. When operating in code/credential verification mode, the fingerprint analysis scanner shall allow passage when the fingerprint data from the verification attempt matches a fingerprint template associated with the identification code. When entered into a keypad or it matches the fingerprint template associated with credential, the card data will then be recognized by the card reader.
  11. Shall store template transactions involving fingerprint scans. The template match scores shall be stored in the matching personnel data file in a format compatible with the system application software, and shall be used for report generation.
  12. Shall be unit listed as FIPS 201 Approved product.
- L. Iris Verification:
1. Shall utilize unique patterns within the human eye to identify authorized, enrolled personnel.
  2. Shall use ambient light to capture an image of the iris of the person presenting themselves for identification. The resulting video image shall be compared against a stored template that was captured during the enrollment process.
  3. Shall utilize a threshold for identification. The efficiency and accuracy of the device shall not be adversely affected by enrollees who wear contact lenses or eye glasses.
  4. Shall provide a means for enrollees to align their eye for identification that does not require facial contact with the device.
  5. Initiation for the scan should be automatic, but push-button could be provided to initiate the scan process. The device shall include adjustments to accommodate differences in enrollee height and mounting height shall be UFAS compliant.
  6. The LED or other type of visual indicator displays shall provide a visual or visual and audible status indication and enrollee prompts. The display shall indicate power on/off, and whether user passage requests have been accepted or rejected.
  7. Verification time for the retinal verification unit shall be no greater than 1.5 seconds from the moment the action is initiated until a response signal has been generated.
  8. Shall provide an enrollment mode, recognition mode, and code/credential verification mode:
    - a. The enrollment mode shall create an iris template for new personnel and enter the template into the system database file created for that person. Template information shall be compatible with the system application software.
    - b. When operating in recognition mode, the retinal verification unit shall allow passage when the retinal verification data from the verification attempt matches an iris template stored in the database files.
    - c. When operating in code/credential verification mode, the iris scanner shall allow passage when the retinal verification data from the verification attempt matches the retinal verification template. This will occur when the associated information matches the identification code entered into a keypad or matches the retinal verification template associated with the credential card data when recognized by a card reader.
  9. Shall store template transactions involving retinal verifications. The template match scores shall be stored in the matching personnel data file in a file format compatible with the system application software, and shall be used for report generation.
- M. Voice Verification:
1. Shall utilize unique patterns within the human speech pattern to identify authorized, enrolled personnel.
  2. Shall digitize a profile of a person's speech to produce a stored model voice print, or template. Users shall record their full names utilizing their natural voice tendencies. This process shall be initiated by a push to talk button on the voice verification device.
  3. Shall utilize a threshold for identification. The efficiency and accuracy of the device shall not be adversely affected by enrollees who have a speech impediment.
  4. Shall provide a means for enrollees to align their voice for identification that does not require contact with the device.

5. The LED or other type of visual indicator displays shall provide a visual or visual and audible status indication and enrollee prompts. The display shall indicate power on/off, and whether user passage requests have been accepted or rejected.
6. Verification time for the voice verification unit shall be no greater than 1.5 seconds from the moment the action is initiated until a response signal has been generated.
7. Shall provide an enrollment mode, recognition mode, and code/credential verification mode:
  - a. The enrollment mode shall create a voice template for new personnel and enter the template into the system database file created for that person. Template information shall be compatible with the system application software.
  - b. When operating in recognition mode, the voice verification unit shall allow passage when the voice verification data from the verification attempt matches a voice template stored in the database files.
  - c. When operating in code/credential verification mode, the voice verifier shall allow passage when the voice verification data from the verification attempt matches the voice verification template. This will occur when the associated information of the identification code entered into a keypad matches the voice verification template associated with a credential card data is recognized by a card reader.
8. Shall store template transactions involving voice verifications. The template match scores shall be stored in the matching personnel data file in a file format compatible with the system application software, MPEG or equivalent, and shall be used for report generation.

## **2.12 KEYPADS**

- A. Designed for use with unique combinations of alphanumeric and other symbols as an Identifier. Keys of keypads shall contain an integral alphanumeric/special symbol keyboard with symbols arranged ascending ASCII-code ordinal sequence or random scrambled order. Communications protocol shall be compatible with Controller.
  1. Keypad display or enclosure shall limit viewing angles of the keypad as follows:
    - a. Maximum Horizontal Viewing Angle: 5 degrees or less off in either direction of a vertical plane perpendicular to the plane of the face of the keypad display.
    - b. Maximum Vertical Viewing Angle: 15 degrees or less off in either direction of a horizontal plane perpendicular to the plane of the face of the keypad display.
  2. Duress Codes: Provide duress situation indication by entering a special code.

## **2.13 CREDENTIAL CARDS**

- A. Personal Identity Verification (PIV) credential cards shall comply to Federal Information Processing Standards Publication (FIPS) 201.
- B. Visual Card Topography shall be compliant with NIST 800-104.
- C. PIV logical credentials shall contain multiple data elements for the purpose of verifying the cardholder's identity at graduated assurance levels. These mandatory data elements shall collectively comprise the data model for PIV logical credentials, and include the following:
  1. CHUID
  2. PIN
  3. PIV authentication data (one asymmetric key pair and corresponding certificate).
  4. Two biometric fingerprints.
- D. The credential card (PIV) shall be an ISO 14443 type smart card with contactless interface that operates at 13.56 MHz.

## **2.14 SYSTEM SENSORS AND RELATED EQUIPMENT**

- A. The PACS (Physical Access Control System) and related Equipment provided by the Contractor shall meet or exceed the following performer specifications:
- B. Request to Exit Detectors:

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1. Passive Infrared Request to Exit Motion Detector (REX PIR) (1) The Contractor shall provide a surface mounted motion detector to signal the physical access control system request to exit input. The motion detector shall be a passive infrared sensor designed for wall or ceiling mounting 2134 to 4572 mm (7 to 15 ft) height. The detector shall provide two (2) form "C" (SPDT) relays rated one (1) Amp. @ 30 VDC for DC resistive loads. The detectors relays shall be user adjustable with a latch time from 1-60 seconds. The detector shall also include a selectable relay reset mode to follow the timer or absence of motion. The detection pattern shall be adjustable plus or minus fourteen ( $\pm 14$ ) degrees. The detector shall operate on 12 VDC with approximately 26 mA continuous current draw. The detector shall have an externally visible activation LED. The motion detector shall measure approximately 38 mm H x 158 mm W x 38 mm D (1.5 x 6.25 x 1.5 in). The detector shall be immune to radio frequency interference. The detector shall not activate or set-up on critical frequencies in the range 26 to 950 Megahertz using a 50 watt transmitter located 30.5 cm (1 ft) from the unit or attached wiring. The detector shall be available on gray or black enclosures. The color of the housing shall be coordinated with the surrounding surface.
- C. Guard tour stations:
  1. The guard tour station shall be single gang brushed steel plate flush mounted in a single gang box. The switch shall be a normally open momentary keyed switch.
- D. Delayed Egress (DE)
  1. General:
    - a. The delay egress locking hardware shall provide a method to secure emergency exits and provide an approved delayed emergency exit method. The package shall be Underwriters Laboratories listed as a delay egress-locking device. The delay egress device shall be available to support configurations with both rated and non-rated fire doors. The delay egress device shall comply with Life Safety Codes (NFPA-101, BOCA) as it applies to special locking arrangements for delay egress locks. Unless specifically identified as a non-fire rated opening, all doors shall be equipped with fire rated door hardware. The Contractor shall be responsible for providing all equipment and installation to provide a fully functioning system. Need to amend to use crashbars type mechanical release switches.
  2. The delay-locking device shall include all of the following features:
    - a. Delay Egress Mode
      - 1) The delayed egress device shall be a SDC 101V Series Exit Check with wall mounted control module. Upon activation of an approved panic bar the delay locking device shall begin a delay sequence of 30 seconds; a flush mounted wall LED panel adjacent to the door will indicate initiation of the countdown time. During the 30 second delay period, a local sounding device shall annunciate a tone activation of the delay cycle and verbal exit instructions. At the end of the delay cycle the locking device shall unlock and allow free egress. The reset of the local sounding device shall be user definable and include options to select either local sound until silenced by reset or local sounder silenced upon opening of the door. Unless otherwise indicated the local delay sounder shall be silenced upon opening of the door. The SDC's device trigger output shall be connected to the SMS DGP alarm panel for pre-activation warning. The contractor shall specify the bond sensor option when ordering the delayed egress hardware; this output shall be wired to the SMS DGP to activate an alarm if the door does not lock. Use of reset panel not top mounted device.
      - 2) Delayed egress doors will have bond sensors.
      - 3) Delayed egress activation shall also trigger CCTV call -up.
    - b. Fire Alarm Mode
      - 1) Upon activation of the facility's fire evacuation and water flow alarm signal the delay locking devices shall immediately unlock and provide free egress. The

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Contractor shall provide any required fire alarm relays or interface devices.

- c. Reset Mode
    - 1) The delay egress device shall be manually reset by the Delayed Egress controller located at the door via key switch.
    - 2) The delay egress device shall automatically reset upon fire alarm system reset.
    - 3) The delayed egress shall be resettable through the SMS.
  - d. The Contractor shall provide a Master Open Switch for all the facility's delayed egress hardware, with protective cover and permanent labeling in the Unit Control Room. The switch shall be wired into the fire alarm system to activate the evacuation alarms. When the switch is pressed all delayed egress or evacuation doors shall unlock and generate an alarm at the security console monitor showing and recording time and date of when the switch was pressed. The contractor is responsible for coordinating the wiring and connection with the fire alarm contractor. The Master Open Switch shall be linked to the fire alarm panel for the release of doors locks.
  - e. Each individual delayed egress door shall have the ability to unlock through a manual action on the SMS.
  - f. Unless otherwise indicated the Contractor shall provide all of the above reset methods for each door. All signs will meet the latest ADA requirements.
  - g. Signs
    - 1) The delay egress package shall be provided with a warning sign complying with local code requirements. The warning sign shall be attached to the interior side of the controlled door. The sign shall be located on the interior side of the door above and within 304 mm (12 in) of the panic bar. The sign shall read:  
EMERGENCY EXIT.  
PUSH UNTIL  
ALARM SOUNDS  
DOOR CAN BE OPENED,  
IN 30 SECONDS.
    - 2) Signs shall be coordinated and comply with the building's existing sign specifications. Signs shall include grade 2 Braille.
    - 3) Signs shall meet the current ADA requirements.
    - 4) In instances of code and specification conflicts, the life safety code requirement shall prevail.
    - 5) The Division 10 Contractor shall provide samples for approval with their submittal package.
3. Physical Access Control Interface
- a. The delay egress device shall be capable of interface with card access control systems.
  - b. The system shall include a bypass feature that is activated via a dry contact relay output from the physical access control system. This bypass shall allow authorized personnel to pass through the controlled portal without creating an alarm condition or activating the delay egress cycle. The bypass shall include internal electronic shunts or door switches to prevent activation (re-arming) until the door returns to the closed position. An unused access event shall not cause a false alarm and shall automatically rearm the delay egress lock upon expiration of the programmed shunt time. The delay egress physical access control interface shall support extended periods of automated and/or manual lock and unlock cycles.
- E. Crash Bar:
- 1. Emergency Exit with Alarm (Panic):
    - a. Entry control portals shall include panic bar emergency exit hardware as designed.
    - b. Panic bar emergency exit hardware shall provide an alarm shunt signal to the PACS and SMS.

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- c. The panic bar shall include a conspicuous warning sign with one (1) inch (2.5 cm) high, red lettering notifying personnel that an alarm will be annunciated if the panic bar is operated.
  - d. Operation of the panic bar hardware shall generate an intrusion alarm that reports to both the SMS and Intrusion Detection System. The use of a micro switch installed within the panic bar shall be utilized for this.
  - e. The panic bar shall utilize a fully mechanical connection only and shall not depend upon electric power for operation.
  - f. The panic bar shall be compatible with mortise or rim mount door hardware and shall operate by retracting the bolt manually by either pressing the panic bar or with a key by-pass. Refer to Section 2.2.1.9 for key-bypass specifications.
  - g. Normal Exit:
    - 1) Entry control portals shall include panic bar non-emergency exit hardware as designed.
    - 2) Panic bar non-emergency exit hardware shall be monitored by and report to the SMS.
    - 3) Operation of the panic bar hardware shall not generate a locally audible or an intrusion alarm within the IDS.
    - 4) When exiting, the panic bar shall depend upon a mechanical connection only. The exterior, non-secure side of the door shall be provided with an electrified thumb latch or lever to provide access after the credential I.D. authentication by the SMS.
    - 5) The panic bar shall be compatible with mortise or rim mount door hardware and shall operate by retracting the bolt manually by either pressing the panic bar or with a key by-pass. Refer to Section 2.2.1.9 for key-bypass specifications. The strikes/bolts shall include a micro switch to indicate to the system when the bolt is not engaged or the strike mechanism is unlocked. The signal switches shall report a forced entry to the system in the event the door is left open or accessed without the identification credentials.
- F. Key Bypass:
- 1. Shall be utilized for all doors that have a mortise or rim mounted door hardware.
  - 2. Each door shall be individually keyed with one master key per secured area.
  - 3. Cylinders shall be six (6)-pin and made of brass or equivalent. Keys for the cylinders shall be constructed of solid material and produced and cut by the same distributor. Keys shall not be purchased, cut, and supplied by multiple dealers.
  - 4. All keys shall have a serial number cut into the key. No two serial numbers shall be the same.
  - 5. All keys and cylinders shall be stored in a secure area that is monitored by the Intrusion Detection System.
- G. Automatic Door Opener and Closer:
- 1. Shall be low energy operators.
  - 2. Door closing force shall be adjustable to ensure adequate closing control.
  - 3. Shall have an adjustable back-check feature to cushion the door opening speed if opened violently.
  - 4. Motor assist shall be adjustable from 0 to 30 seconds in five (5) second increments. Motor assist shall restart the time cycle with each new activation of the initiating device.
  - 5. Unit shall have a three-position selector mode switch that shall permit unit to be switched "ON" to monitor for function activation, switched to "H/O" for indefinite hold open function or switched to "OFF," which shall deactivate all control functions but will allow standard door operation by means of the internal mechanical closer.
  - 6. Door control shall be adjustable to provide compliance with the requirements of the Americans with Disabilities Act (ADA) and ANSI standards A117.1.
  - 7. All automatic door openers and closers shall:



- a. Meet UL standards.
  - b. Be fire rated.
  - c. Have push and go function to activate power operator or power assist function.
  - d. Have push button controls for setting door close and door open positions.
  - e. Have open obstruction detection and close obstruction detection built into the unit.
  - f. Have door closer assembly with adjustable spring size, back-check valve, sweep valve, latch valve, speed control valve and pressure adjustment valve to control door closing.
  - g. Have motor start-up delay, vestibule interface delay; electric lock delay and door hold open delay up to 30 seconds. All operators shall close door under full spring power when power is removed.
  - h. Are to be hard wired with power input of 120 VAC, 60Hz and connected to a dedicated circuit breaker located on a power panel reserved for security equipment.
- H. Door Status Indicators:
1. Shall monitor and report door status to the SMS.
  2. Door Position Sensor:
    - a. Shall provide an open or closed indication for all doors operated on the PACS and report directly to the SMS.
    - b. Shall also provide alarm input to the Intrusion Detection System for all doors operated by the PACS and all other doors that require monitoring by the intrusion detection system.
    - c. Switches for doors operated by the PACS shall be double pole double throw (DPDT). One side of the switch shall monitor door position and the other side if the switch shall report to the intrusion detection system. For doors with electromagnetic locks a magnetic bonding sensor (MBS) can be used in place of one side of a DPDT switch, in turn allowing for the use of a single pole double throw (SPDT) switch in it place of a DPDT switch.
    - d. Switches for doors not operated by the PACS shall be SPDT and report directly to the IDS.
    - e. Shall be surface or flush mounted and wide gap with the ability to operate at a maximum distance of up to 2" (5 cm).

## **2.15 PUSH BUTTON SWITCHES**

- A. Push-Button Switches: Momentary-contact back-lighted push buttons, with stainless-steel switch enclosures.
1. Electrical Ratings:
    - a. Minimum continuous current rating of 10 A at 120V ac or 5 A at 240V ac.
    - b. Contacts that will make 720 VA at 60 A and that will break at 720 VA at 10 A.
  2. Enclosures: Flush or surface mounting. Push buttons shall be suitable for flush mounting in the switch enclosures.
  3. Enclosures shall additionally be suitable for installation in the following locations:
    - a. Indoors, controlled environment.
    - b. Indoors, controlled environment.
  4. Power: Push-button switches shall be powered from their associated Controller, using dc control.

## **2.16 PORTAL CONTROL DEVICES**

- A. Shall be used to assist the PACS.
- B. Such devices shall:
1. Provide a means of monitoring the doors status.
  2. Allow for exiting a space via either a push button, request to exit, or panic/crash bar.
  3. Provide a means of override to the PACS via a keypad or key bypass.
  4. Assist door operations utilizing automatic openers and closures.

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5. Provide a secondary means of access to a space via a keypad.
- C. Shall be connected to and monitored by the main PACS panel.
- D. Shall be installed in a manner that they comply with:
  1. The Uniform Federal Accessibility Standards (UFAS)
  2. The Americans with Disabilities Act (ADA)
  3. The ADA Standards for Accessible Design
- E. Shall provide a secondary means of physical access control within a secure area.
- F. Push-Button Switches:
  1. Shall be momentary contact, back lighted push buttons, and stainless steel switch enclosures for each push button as shown. Buttons are to be utilized for secondary means of releasing a locking mechanism.
    - a. In an area where a push button is being utilized for remote access of the locking device then no more than two (2) buttons shall operate one door from within one secure space. Buttons will not be wired in series with one other.
    - b. In an area where locally stationed guards control entry to multiple secure points via remote switches. An interface board shall be designed and constructed for only the amount of buttons it shall house. These buttons shall be flush mounted and clearly labeled for ease of use. All buttons shall be connected to the PACS and SMS system for monitoring purposes.
    - c. Shall have double-break silver contacts that will make 720 VA at 60 amperes and break 720 VA at 10 amperes.
- G. Entry Control Devices:
  1. Shall be hardwired to the PACS main control panel and operated by either a card reader or a biometric device via a relay on the main control panel.
  2. Shall be fail-safe in the event of power failure to the PACS system.
  3. Shall operate at 24 VCD, with the exception of turnstiles and be powered by a separate power supply dedicated to the door control system. Each power supply shall be rated to operate a minimum of two doors simultaneously without error to the system or overload the power supply unit.
  4. Shall have a diode or metal-oxide varistor (MOV) to protect the controller and power supply from reverse current surges or back-check.
  5. Electric Strikes/Bolts: Shall be:
    - a. Made of heavy-duty construction and tamper resistant design.
    - b. Tested to over one million cycles.
    - c. Rated for a minimum of 1000 lbs. holding strength.
    - d. Utilize an actuating solenoid for the strike/bolt. The solenoid shall move from fully open to fully closed position and back in not more than 500 milliseconds and be rated for continuous duty.
    - e. Utilize a signal switch that will indicate to the system if the strike/bolt is not engaged or is unlocked when it should be secured.
    - f. Flush mounted within the door frame.
  6. Electric Mortise Locks: Shall be installed within the door and an electric transfer hinge shall be utilized to allow the wires to be transferred from the door frame to the lock. If utilized with a double door then the lock shall be installed inside the active leaf. Electric Mortise Locks shall:
    - a. These locks shall be provided and installed by the Division 8 "DOOR HARDWARE" Contractor.
    - b. Have integrated Request to Exit switch for doors receiving physical access control devices.
    - c. Provide integration of the Electric Mortise Locks with the PACS for:
      - 1) Lock Power

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- 2) Request to Exit switch.
7. Electromagnetic Locks:
- a. These locks shall be without mechanical linkage utilizing no moving parts, and securing the door to its frame solely on electromagnetic force.
  - b. Shall be comprised of two pieces, the mag-lock and the door plate. The electromagnetic locks shall be surface mounted to the door frame and the door plate shall be surface mounted to the door.
  - c. Ensure a diode is installed in line with the DC voltage supplying power to the unit in order to prevent back-check on the system when the electromagnetic lock is powered.
  - d. Shall utilize a magnetic bonding sensor (MBS) to monitor the door status and report that status to the SMS.
  - e. Electromagnetic locks shall meet the following minimum technical characteristics:
- |                   |               |                   |
|-------------------|---------------|-------------------|
| Operating Voltage | 24 VDC        |                   |
| Current Draw      | .5A           |                   |
| Holding Force     | Swing Doors   | 675 kg (1500 lbs) |
|                   | Sliding Doors | 225 kg (500 lbs)  |
8. Turnstiles:
- a. Shall operate at 110 VAC, 60 Hz or 220 VAC, 50 Hz supplied from a dedicated circuit breaker on a security power panel. This device does not require a back-up power source.
  - b. Shall be utilized as a means of monitoring and controlling access in a lobby.
  - c. Shall meet the following minimum requirements:
    - 1) Be UFAS compliant.
    - 2) Provide either an audible or visual confirmation that access has been granted to a cleared individual.
    - 3) Provide an audible alarm in the event a non-cleared individual is attempting to gain access.
    - 4) Interface with the SMS and utilize a card reader for accessing and exiting a facility, and provide a recorded event of personnel accessing these points.
    - 5) Have a built-in step-down transformer to provide power to a card reader unit.
    - 6) Have built-in signal wiring chassis to allow for plug and play capabilities with the PACS.
    - 7) Have the ability to detect tailgating within one quarter on an inch to prevent unauthorized access to a facility.

**2.17 INTERFACES**

- A. CCTV System Interface
1. An RS232 [Ethernet] interface associated driver, and controller shall be provided for connection of the SMS Central Computer to the CCTV Alarm interface and switcher. The interface shall provide alarm data to the CCTV Alarm interface for automatic camera call-up. If required the Security Contractor shall be responsible for programming the command strings into the SMS Server
- B. Intercom System Interface
1. The CCTV call-up from intercom stations shall be through the intercom unit via RS232 [Ethernet] communications interface to the SMS system, then through the matrix switcher.
  2. Application Software
    - a. Provides the interface between the Alarm Annunciation System and Operator; all sensors, local processors and data links, drive displays, report alarms, and report generation.
    - b. Software is categorized as System Software and Application Software. System Software must consist of software to support set-up, operation, hard drive back-ups

and maintenance processor. Application Software must consist of software to provide the completion of Physical Access Control System.

C. Power Supplies:

1. Shall be UL rated and able to adequately power (enter number) entry control devices on a continuous base without failure.
2. Shall meet the following minimum technical characteristics:

INPUT POWER	110 VAC 60 HZ (enter amperage)A
OUTPUT VOLTAGE	12 VDC Nominal (13.8 VDC) 24 VDC Nominal (27.6 VDC) Filtered and Regulated
BATTERY	Dependant on Output Voltage shall provide up to <__> Ah
OUTPUT CURRENT	[10] amp max. [@ 13.8] VDC [5] amp max. [@ 27.6] VDC
PRIMARY FUSE SIZE	6.3 amp (non-removable)
BATTERY FUSE SIZE	12 amp, 3AG
CHARGING CIRCUIT	Built-in standard

**2.18 AFTER-HOURS HVAC CONTROL**

- A. After-Hours HVAC Control. Provide for any credential read to activate or control individual HVAC zones based on access level. This control module shall control and record the after hours use of the heating and cooling system in zones or tenant space.
  1. This control shall give the administrator the ability to determine how much extra energy consumption each tenant is responsible for. This information can be used in billing tenants for the extra after-hour usage.
  2. At the specified time every day, the HVAC shall automatically go into its after-hours mode. It shall then revert into its normal business hours mode by a tenant using an access code or card at a designated keypad or reader.
  3. Once enabled, the tenant's HVAC zone shall be under thermostat control for a preset amount of time. When the preset amount of time elapses, the HVAC for that zone shall revert back to after-hours mode unless a tenant uses his/her code or card again. This shall continue until the unit automatically returns to its normal business hours operation.
- B. Control module activates the HVAC system after a valid access by any of three methods; however, the HVAC control shall always allow for manual override from the PC.
  1. By time expiration after access of an adjustable period from 1 second to 546 minutes (9.1 hours).
  2. By use of the card or code again at the same or different reader or keypad.
  3. By system returning to its normal business hours operation.
- C. After-hours HVAC control shall operate with all other features running simultaneously and use the central-station PC that controls access for the building but shall not rely on the host PC for any HVAC control decisions.

**2.19 REAL TIME GUARD TOUR**

- A. Guard tour module shall provide the ability to plan, track, and route tours. Module shall input an alarm during tour if guard fails to make a station. Tours can be programmed for sequential or random tour-station order.
  1. Guard tour setup shall define specific routes or tours for the guard to take, with time restrictions in which to reach every predefined tour station.
  2. Guard tour activity shall be automatically logged to the central-station PC's hard drive.
  3. If the guard is early or late to a tour station, a unique alarm per station shall appear at the Central Station to indicate the time and station.

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4. Guard tour setup shall allow the tours to be executed sequentially or in a random order with an overall time limit set for the entire tour instead of individual times for each tour station.
  5. Setup shall allow recording of predefined responses that will display for the operator at the control station should a "Failed to Check-in" alarm occur.
- B. A tour station is a physical location a guard shall reach and perform an action indicating that the guard has arrived. This action, performed at the tour station, shall be 1 of 13 different events with any combination of station types within the same tour. A tour station shall be one of the following event types:
1. Access Granted.
  2. Access Denied Code.
  3. Access Denied Card plus PIN.
  4. Access Denied Time Zone.
  5. Access Denied Level.
  6. Access Denied Facility.
  7. Access Denied Code Timer.
  8. Access Denied Anti-Passback.
  9. Access Granted Passback Violation.
  10. Alarm.
  11. Restored.
  12. Input Normal.
  13. Input Abnormal.
- C. Guard tour and other system features shall operate simultaneously with no interference.
- D. Guard Tour Module Capacity: 999 possible guard tour definitions with each tour having up to 99 tour stations. System shall allow all 999 tours to be running at same time.

## **2.20 VIDEO AND CAMERA CONTROL**

- A. Control station or designated workstation displays live video from a CCTV source.
1. Control Buttons: On the display window, with separate control buttons to represent Left, Right, Up, Down, Zoom In, Zoom Out, Scan, and a minimum of two custom command auxiliary controls.
  2. Provide at least seven icons to represent different types of cameras, with ability to import custom icons. Provide options for display of icons on graphic maps to represent their physical location.
  3. Provide the alarm-handling window with a command button that will display the camera associated with the alarm point.
- B. Display mouse-selectable icons representing each camera source, to select source to be displayed. For CCTV sources that are connected to a video switcher, control station shall automatically send control commands through a COM port to display the requested camera when the camera icon is selected.
- C. Allow cameras with preset positioning to be defined by displaying a different icon for each of the presets. Provide control with Next and Previous buttons to allow operator to cycle quickly through the preset positions.

## **2.21 WIRES AND CABLES**

- A. Comply with Division 28 Section "CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY."
- B. PVC-Jacketed, RS-232 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage; PVC jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
1. NFPA 70, Type CM.

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2. Flame Resistance: UL 1581 Vertical Tray.
- C. Plenum-Type, RS-232 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage; plastic jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
  1. NFPA 70, Type CMP.
  2. Flame Resistance: NFPA 262 Flame Test.
- D. RS-485 communications require 2 twisted pairs, with a distance limitation of 4000 feet (1220 m).
- E. PVC-Jacketed, RS-485 Cable: Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, PVC insulation, unshielded, PVC jacket, and NFPA 70, Type CMG.
- F. Plenum-Type, RS-485 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and fluorinated-ethylene-propylene jacket.
  1. NFPA 70, Type CMP.
  2. Flame Resistance: NFPA 262 Flame Test.
- G. Multiconductor, Readers and Wiegand Keypads Cables: No. 22 AWG, paired and twisted multiple conductors, stranded (7x30) tinned copper conductors, semirigid PVC insulation, overall aluminum foil-polyester tape shield with 100 percent shield coverage, plus tinned copper braid shield with 65 percent shield coverage, and PVC jacket.
  1. NFPA 70, Type CMG.
  2. Flame Resistance: UL 1581 Vertical Tray.
  3. For TIA/EIA-RS-232 applications.
- H. Paired Readers and Wiegand Keypads Cables: Paired, 3 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, individual aluminum foil-polyester tape shielded pairs each with No. 22 AWG, stranded tinned copper drain wire, 100 percent shield coverage, and PVC jacket.
  1. NFPA 70, Type CM.
  2. Flame Resistance: UL 1581 Vertical Tray.
- I. Paired Readers and Wiegand Keypads Cable: Paired, 3 pairs, twisted, No. 20 AWG, stranded (7x28) tinned copper conductors, polyethylene (polyolefin) insulation, individual aluminum foil-polyester tape shielded pairs each with No. 22 AWG, stranded (19x34) tinned copper drain wire, 100 percent shield coverage, and PVC jacket.
  1. NFPA 70, Type CM.
  2. Flame Resistance: UL 1581 Vertical Tray.
- J. Plenum-Type, Paired, Readers and Wiegand Keypads Cable: Paired, 3 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, individual aluminum foil-polypropylene tape shielded pairs each with No. 22 AWG, stranded tinned copper drain wire, 100 percent shield coverage, and fluorinated-ethylene-propylene jacket.
  1. NFPA 70, Type CMP.
  2. Flame Resistance: NFPA 262 Flame Test.
- K. Plenum-Type, Multiconductor, Readers and Keypads Cable: 6 conductors, No. 20 AWG, stranded (7x28) tinned copper conductors, fluorinated-ethylene-propylene insulation, overall aluminum foil-polyester tape shield with 100 percent shield coverage plus tinned copper braid shield with 85 percent shield coverage, and fluorinated-ethylene-propylene jacket.
  1. NFPA 70, Type CMP.
  2. Flame Resistance: NFPA 262 Flame Test.
- L. Paired Lock Cable: 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
  1. NFPA 70, Type CMG.

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2. Flame Resistance: UL 1581 Vertical Tray.
- M. Plenum-Type, Paired Lock Cable: 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
  1. NFPA 70, Type CMP.
  2. Flame Resistance: NFPA 262 Flame Test.
- N. Paired Lock Cable: 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
  1. NFPA 70, Type CMG.
  2. Flame Resistance: UL 1581 Vertical Tray.
- O. Plenum-Type, Paired Lock Cable: 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and plastic jacket.
  1. NFPA 70, Type CMP.
  2. Flame Resistance: NFPA 262 Flame Test.
- P. Paired Input Cable: 1 pair, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, overall aluminum foil-polyester tape shield with No. 22 AWG, stranded (7x30) tinned copper drain wire, 100 percent shield coverage, and PVC jacket.
  1. NFPA 70, Type CMR.
  2. Flame Resistance: UL 1666 Riser Flame Test.
- Q. Plenum-Type, Paired Input Cable: 1 pair, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, aluminum foil-polyester tape shield (foil side out), with No. 22 AWG drain wire, 100 percent shield coverage, and plastic jacket.
  1. NFPA 70, Type CMP.
  2. Flame Resistance: NFPA 262 Flame Test.
- R. Paired AC Transformer Cable: 1 pair, twisted, No. 18 AWG, stranded (7x26) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
  1. NFPA 70, Type CMG.
- S. Plenum-Type, Paired AC Transformer Cable: 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and plastic jacket.
  1. NFPA 70, Type CMP.
  2. Flame Resistance: NFPA 262 Flame Test.
- T. Elevator Travel Cable: Steel center core, with shielded, twisted pairs, No. 20 AWG conductor size.
  1. Steel Center Core Support: Preformed, flexible, low-torsion, zinc-coated, steel wire rope; insulated with 60 deg C flame-resistant PVC and covered with a nylon or cotton braid.
  2. Shielded Pairs: Insulated copper conductors; color-coded, insulated with 60 deg C flame-resistant PVC; each pair shielded with bare copper braid for 85 percent coverage.
  3. Jute Filler: Electrical grade, dry.
  4. Binder: Helically wound synthetic fiber.
  5. Braid: Rayon or cotton braid applied with 95 percent coverage.
  6. Jacket: 60 deg C PVC specifically compounded for flexibility and abrasion resistance. UL VW-1 and CSA FT1 flame rated.
- U. LAN (Ethernet) Cabling: Comply with Division 28 Section "Conductors and Cables for Electronic Safety and Security."

### **PART 3 - EXECUTION**

#### **3.01 GENERAL**

- A. The Contractor shall install all system components and appurtenances in accordance with the manufacturers' instructions, ANSI C2, and shall furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified. Control

signals, communications, and data transmission lines grounding shall be installed as necessary to preclude ground loops, noise, and surges from affecting system operation. Equipment, materials, installation, workmanship, inspection, and testing shall be in accordance with manufacturers' recommendations and as modified herein.

- B. Consult the manufacturers' installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation. Refer to the Riser/Connection diagram for all schematic system installation/termination/wiring data.
- C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., sensors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

### **3.02 CURRENT SITE CONDITIONS**

- A. The Contractor shall visit the site and verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions which will affect performance of the system to the Owner in a report as defined in paragraph Group II Technical Data Package. The Contractor shall not take any corrective action without written permission from the Owner.

### **3.03 EXAMINATION**

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.
- B. Examine roughing-in for LAN and control cable conduit systems to PCs, Controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.04 PREPARATION**

- A. Comply with recommendations in SIA CP-01.
- B. Comply with EIA/TIA-606, "Administration Standard for the Telecommunications Infrastructure of Commercial Buildings."
- C. Obtain detailed Project planning forms from manufacturer of access-control system; develop custom forms to suit Project. Fill in all data available from Project plans and specifications and publish as Project planning documents for review and approval.
  - 1. Record setup data for control station and workstations.
  - 2. For each Location, record setup of Controller features and access requirements.
  - 3. Propose start and stop times for time zones and holidays, and match up access levels for doors.
  - 4. Set up groups, linking, and list inputs and outputs for each Controller.
  - 5. Assign action message names and compose messages.
  - 6. Set up alarms. Establish interlocks between alarms, intruder detection, and video surveillance features.
  - 7. Prepare and install alarm graphic maps.
  - 8. Develop user-defined fields.
  - 9. Develop screen layout formats.
  - 10. Propose setups for guard tours and key control.
  - 11. Discuss badge layout options; design badges.
  - 12. Complete system diagnostics and operation verification.
  - 13. Prepare a specific plan for system testing, startup, and demonstration.
  - 14. Develop acceptance test concept and, on approval, develop specifics of the test.
  - 15. Develop cable and asset management system details; input data from construction documents. Include system schematics and Technical Drawings.



- D. In meetings with Architect and Owner, present Project planning documents and review, adjust, and prepare final setup documents. Use final documents to set up system software.

### **3.05 CABLING**

- A. Comply with NECA 1, "Good Workmanship in Electrical Contracting."
- B. Install cables and wiring according to requirements in Division 28 Section "Conductors and Cables for Electronic Safety and Security."
- C. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces.
- D. Install LAN cables using techniques, practices, and methods that are consistent with Category 5E rating of components and that ensure Category 5E performance of completed and linked signal paths, end to end.
- E. Install cables without damaging conductors, shield, or jacket.
- F. Boxes and enclosures containing security system components or cabling, and which are easily accessible to employees or to the public, shall be provided with a lock. Boxes above ceiling level in occupied areas of the building shall not be considered to be accessible. Junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamperproof screws.
- G. Install end-of-line resistors at the field device location and not at the Controller or panel location.

### **3.06 CABLE APPLICATION**

- A. Comply with EIA/TIA-569 "Commercial Building Standard for Telecommunications Pathways and Spaces"
- B. Cable application requirements are minimum requirements and shall be exceeded if recommended or required by manufacturer of system hardware.
- C. RS-232 Cabling: Install at a maximum distance of 50 feet (15 m).
- D. RS-485 Cabling: Install at a maximum distance of 4000 feet (1220 m).
- E. Card Readers and Keypads:
  - 1. Install number of conductor pairs recommended by manufacturer for the functions specified.
  - 2. Unless manufacturer recommends larger conductors, install No. 22 AWG wire if maximum distance from Controller to the reader is 250 feet (75 m), and install No. 20 AWG wire if maximum distance is 500 feet (150 m).
  - 3. For greater distances, install "extender" or "repeater" modules recommended by manufacturer of the Controller.
  - 4. Install minimum No. 18 AWG shielded cable to readers and keypads that draw 50 mA or more.
- F. Install minimum No. 16 AWG cable from Controller to electrically powered locks. Do not exceed 250 feet (75 m).
- G. Install minimum No. 18 AWG ac power wire from transformer to Controller, with a maximum distance of 25 feet (8 m).

### **3.07 GROUNDING**

- A. Comply with Division 26 Section "Grounding and Bonding for Electrical Systems"
- B. Comply with IEEE 1100, "Power and Grounding Sensitive Electronic Equipment."
- C. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- D. Signal Ground:

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1. Terminal: Locate in each equipment room and wiring closet; isolate from power system and equipment grounding.
2. Bus: Mount on wall of main equipment room with standoff insulators.
3. Backbone Cable: Extend from signal ground bus to signal ground terminal in each equipment room and wiring closet.

### 3.08 INSTALLATION

- A. System installation shall be in accordance with UL 294, manufacturer and related documents and references, for each type of security subsystem designed, engineered and installed.
- B. Components shall be configured with appropriate "service points" to pinpoint system trouble in less than 30 minutes.
- C. The Contractor shall install all system components including Government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, documentation listed in Sections 1.4 and 1.5 of this document, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a operable system.
- D. The PACS will be designed, engineered, installed, and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the system is a stand alone or a network.
- E. For integration purposes, the PACS shall be integrated where appropriate with the following associated security subsystems:
  1. CCTV:
    - a. Provide 24 hour coverage of all entry points to the perimeter and agency buildings. As well as all emergency exits utilizing a fixed color camera.
    - b. Be able to monitor, control and record cameras on a 24 hours basis.
    - c. Be programmed automatically call up a camera when an access point is but into an alarm state.
    - d. For additional PACS system requirements as they relate to the CCTV, refer to Section 28 23 00, VIDEO SURVEILLANCE.
  2. IDS:
    - a. Be able monitor door control sensors.
    - b. Be able to monitor and control the IDS on a 24 hours basis.
    - c. Be programmed to go into an alarm state when an IDS device is put into an alarm state, and notify the operator via an audible alarm.
    - d. For additional PACS system requirements as they relate to the IDS, refer to Section 28 16 11, INTRUSION DETECTION SYSTEM.
  3. Security Access Detection:
    - a. Be able to monitor all objects that have been screened with an x-ray machine and be able to monitor all data acquired by the bomb detection unit.
    - b. For additional PACS system requirements as they relate to the Security Access Detection, refer to Section 28 13 53, SECURITY ACCESS DETECTION.
  4. EPPS:
    - a. Be programmed to go into an alarm state when an emergency call box or duress alarm/panic device is activated, and notify the Physical Access Control System and Database Management of an alarm event.
    - b. For additional PACS requirements as they relate to the EPPS, refer to Section 28 26 00, ELECTRONIC PERSONAL PROTECTION SYSTEM.
- F. Integration with these security subsystems shall be achieved by computer programming or the direct hardwiring of the systems.
- G. For programming purposes refer to the manufacturers requirements for correct system operations. Ensure computers being utilized for system integration meet or exceed the minimum system requirements outlined on the systems software packages.

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- H. The Contractor shall visit the site and verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system. The Contractor shall not take any corrective action without written permission from the Government.
- I. The Contractor shall visit the site and verify that site conditions are in agreement/compliance with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Contracting Officer in the form of a report. The Contractor shall not take any corrective action without written permission received from the Contracting Officer.
- J. Existing Equipment:
  - 1. The Contractor shall connect to and utilize existing door equipment, control signal transmission lines, and devices as outlined in the design package. Door equipment and signal lines that are usable in their original configuration without modification may be reused with Contracting Officer approval.
  - 2. The Contractor shall perform a field survey, including testing and inspection of all existing door equipment and signal lines intended to be incorporated into the PACS, and furnish a report to the Contracting Officer as part of the site survey report. For those items considered nonfunctioning, provide (with the report) specification sheets, or written functional requirements to support the findings and the estimated cost to correct the deficiency. As part of the report, the Contractor shall include a schedule for connection to all existing equipment.
  - 3. The Contractor shall make written requests and obtain approval prior to disconnecting any signal lines and equipment, and creating equipment downtime. Such work shall proceed only after receiving Contracting Officer approval of these requests. If any device fails after the Contractor has commenced work on that device, signal or control line, the Contractor shall diagnose the failure and perform any necessary corrections to the equipment.
  - 4. The Contractor shall be held responsible for repair costs due to Contractor negligence, abuse, or improper installation of equipment.
  - 5. The Contracting Officer shall be provided a full list of all equipment that is to be removed or replaced by the Contractor, to include description and serial/manufacturer numbers where possible. The Contractor shall dispose of all equipment that has been removed or replaced based upon approval of the Contracting Officer after reviewing the equipment removal list. In all areas where equipment is removed or replaced the Contractor shall repair those areas to match the current existing conditions.
- K. Enclosure Penetrations: All enclosure penetrations shall be from the bottom of the enclosure unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and all penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water and will comply with VA Master Specification 07 84 00, Firestopping. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer and in such a manner that the cable is not damaged.
- L. Cold Galvanizing: All field welds and brazing on factory galvanized boxes, enclosures, and conduits shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.
- M. Control Panels:
  - 1. Connect power and signal lines to the controller.
  - 2. Program the panel as outlined by the design and per the manufacturer's programming guidelines.
- N. SMS:
  - 1. Coordinate with the VA agency's IT personnel to place the computer on the local LAN or Intranet and provide the security system protection levels required to insure only

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- authorized VA personnel have access to the system.
- 2. Program and set-up the SMS to ensure it is in fully operation.
- O. Card Readers:
  - 1. Connect all signal inputs and outputs as shown and specified.
  - 2. Terminate input signals as required.
  - 3. Program and address the reader as per the design package.
  - 4. Readers shall be surface or flushed mounted and all appropriate hardware shall be provided to ensure the unit is installed in an enclosed conduit system.
- P. Biometrics:
  - 1. Connect all signal input and output cables along with all power cables.
  - 2. Program and ensure the device is in operating order.
- Q. Portal Control Devices:
  - 1. Install all signal input and output cables as well as all power cables.
  - 2. Devices shall be surface or flush mounted as per the design package.
  - 3. Program all devices and ensure they are working.
- R. Door Status Indicators:
  - 1. Install all signal input and output cables as well as all power cables.
  - 2. RTE's shall be surface mounted and angled in a manner that they cannot be compromised from the non-secure side of a windowed door, or allow for easy release of the locking device from a distance no greater than 6 feet from the base of the door.
  - 3. Door position sensors shall be surface or flush mounted and wide gap with the ability to operate at a maximum distance of up to 2" (5 cm).
- S. Entry Control Devices:
  - 1. Install all signal input and power cables.
  - 2. Strikes and bolts shall be mounted within the door frame.
  - 3. Mortise locks shall be mounted within the door and an electric transfer hinge shall be utilized to transfer the wire from within the door frame to the mortise lock inside the door.
  - 4. Electromagnetic locks shall be installed with the mag-lock mounted to the door frame and the metal plate mounted to the door.
- T. System Start-Up:
  - 1. The Contractor shall not apply power to the PACS until the following items have been completed:
    - a. PACS equipment items and have been set up in accordance with manufacturer's instructions.
    - b. A visual inspection of the PACS has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
    - c. System wiring has been tested and verified as correctly connected as indicated.
    - d. All system grounding and transient protection systems have been verified as installed and connected as indicated.
    - e. Power supplies to be connected to the PACS have been verified as the correct voltage, phasing, and frequency as indicated.
  - 2. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage as a result of Contractor work efforts.
  - 3. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior notice.
- U. Supplemental Contractor Quality Control:
  - 1. The Contractor shall provide the services of technical representatives who are familiar with all components and installation procedures of the installed PACS; and are approved by the Contracting Officer.

2. The Contractor will be present on the job site during the preparatory and initial phases of quality control to provide technical assistance.
3. The Contractor shall also be available on an as needed basis to provide assistance with follow-up phases of quality control.
4. The Contractor shall participate in the testing and validation of the system and shall provide certification that the system installed is fully operational as all construction document requirements have been fulfilled.

### **3.09 SYSTEM SOFTWARE**

- A. Install, configure, and test software and databases for the complete and proper operation of systems involved. Assign software license to Owner.

### **3.10 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect test and adjust field-assembled components and equipment installation, including connections and to assist in field testing. Report results in writing.
- B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports:
- C. Perform the following field tests and inspections and prepare test reports:
  1. LAN Cable Procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts. Use Class 2, bidirectional, Category 6 tester. Test for faulty connectors, splices, and terminations. Test according to TIA/EIA-568-1, "Commercial Building Telecommunications Cabling Standards - Part 1 General Requirements." Link performance for UTP cables must comply with minimum criteria in TIA/EIA-568-B.
  2. Test each circuit and component of each system. Tests shall include, but are not limited to, measurements of power supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of the calculated battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.
  3. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.

### **3.11 PROTECTION**

- A. Maintain strict security during the installation of equipment and software. Rooms housing the control station, and workstations that have been powered up shall be locked and secured, with an activated burglar alarm and access-control system reporting to a Central Station complying with UL 1610, "Central-Station Burglar-Alarm Units," during periods when a qualified operator in the employ of Contractor is not present.

### **3.12 COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of Section 28 08 00 – COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 28 08 00 – COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS and related sections for contractor responsibilities for system commissioning.

### **3.13 DEMONSTRATION AND TRAINING**

- A. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.

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- B. Submit training plans and instructor qualifications in accordance with the requirements of Section 28 08 00 – COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.
- C. Develop separate training modules for the following:
  - 1. Computer system administration personnel to manage and repair the LAN and databases and to update and maintain software.
  - 2. Operators who prepare and input credentials to man the control station and workstations and to enroll personnel.
  - 3. Security personnel.
  - 4. Hardware maintenance personnel.
  - 5. Corporate management.
- D. All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.

**END OF SECTION**

**SECTION 281316**  
**PHYSICAL ACCESS CONTROL SYSTEM AND DATABASE MANAGEMENT**

**PART 1 – GENERAL**

**1.01 DESCRIPTION**

- A. This section specifies the finishing, installation, connection, testing and certification of a complete and fully operation Physical Access Control Database Management System, hereinafter referred to as the PACMS.
- B. This Section includes a Physical Security Access System Database Management consisting of database management software. Requirements for hardware supporting database management are described in Section 28 13 00 PHYSICAL ACCESS CONTROL, Part 2.

**1.02 RELATED WORK**

- A. SPEC WRITER NOTE: Delete any item or paragraph not applicable in the section and renumber the paragraphs.
- B. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- C. Section 28 05 00 – COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. Requirements for general requirements that are common to more than one section in Division 28.
- D. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.
- E. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding and bonding.
- F. Section 28 05 28.33 - CONDUITS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.
- G. Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS. For requirements for commissioning and systems readiness checklists.
- H. Section 28 13 00 - PHYSICAL ACCESS CONTROL SYSTEM. Requirements for physical access control system.
- I. Section 28 16 00 - INTRUSION DETECTION SYSTEM (IDS). Requirements for alarm systems.
- J. Section 28 23 00 - VIDEO SURVEILLANCE. Requirements for security camera systems.
- K. Section 28 26 00 - ELECTRONIC PERSONAL PROTECTION SYSTEM (EPPS). Requirements for emergency and interior communications.

**1.03 QUALITY ASSURANCE**

- A. The Contractor shall be responsible for providing, installing, and the operation of the Access Control System and Database Management as shown. The Contractor shall also provide certification as required.
- B. The security system shall be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the security system is stand-alone or a part of a Information Technology (IT) computer network.
- C. The Contractor or security sub-contractor shall be a licensed security Contractor as required within the state or jurisdiction of where the installation work is being conducted.
- D. The manufacturers of all hardware and software components employed in the SMS shall be established vendors to the access control/security monitoring industry for no less than five (5) years and shall have successfully implemented at least 5 systems of similar size and complexity.
- E. Contractor / Integrator Qualifications

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1. The security system integrator shall have been regularly engaged in the installation and maintenance of integrated access control systems and have a proven track record with similar systems of the same size, scope, and complexity.
  2. The security system integrator shall supply information attesting to the fact that their firm is an authorized product integrator certified with the SMS. A minimum of one technician shall be a installer certified by the SMS manufacturer.
  3. The security system integrator shall supply information attesting to the fact that their installation and service technicians are competent factory trained and certified personnel capable of maintaining the system and providing reasonable service time.
  4. The security system integrator shall provide a minimum of three (3) references whose systems are of similar complexity and have been installed and maintained by the security system integrator in the last five (5) years.
  5. There shall be a local representative and factory authorized local service organization that shall carry a complete stock of parts and provide maintenance for these systems.
- F. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within eight hours of receipt of notification that service is needed. Submit name and address of service organizations.

#### 1.04 SUBMITTALS

- A. Submit below items in conjunction with Master Specification Sections 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and Section 02 41 00, DEMOLITION.
- B. Provide certificates of compliance with Section 1.3, Quality Assurance.
- C. Provide a pre-installation and as-built design package in both electronic format and on paper, minimum size 48 x 48 inches (1220mm x 1220mm); drawing submittals shall be per the established project schedule.
- D. Pre-installation design and as-built packages shall include, but not be limited to:
  1. Index Sheet that shall:
    - a. Define each page of the design package to include facility name, building name, floor, and sheet number.
    - b. Provide a list of all security abbreviations and symbols.
    - c. Reference all general notes that are utilized within the design package.
    - d. Specification and scope of work pages for all security systems that are applicable to the design package that will:
      - 1) Outline all general and job specific work required within the design package.
      - 2) Provide a device identification table outlining device Identification (ID) and use for all security systems equipment utilized in the design package.
  2. Drawing sheets that will be plotted on the individual floor plans or site plans shall:
    - a. Include a title block as defined above.
    - b. Define the drawings scale in both standard and metric measurements.
    - c. Provide device identification and location.
    - d. Address all signal and power conduit runs and sizes that are associated with the design of the electronic security system and other security elements (e.g., barriers, etc.).
    - e. Identify all pull box and conduit locations, sizes, and fill capacities.
    - f. Address all general and drawing specific notes for a particular drawing sheet.
  3. A riser drawing for each applicable security subsystem shall:
    - a. Indicate the sequence of operation.
    - b. Relationship of integrated components on one diagram.
    - c. Include the number, size, identification, and maximum lengths of interconnecting wires.



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- d. Wire/cable types shall be defined by a wire and cable schedule. The schedule shall utilize a lettering system that will correspond to the wire/cable it represents (example: A = 18 AWG/1 Pair Twisted, Unshielded). This schedule shall also provide the manufacturer's name and part number for the wire/cable being installed.
  4. A system drawing for each applicable security system shall:
    - a. Identify how all equipment within the system, from main panel to device, shall be laid out and connected.
    - b. Provide full detail of all system components wiring from point-to-point.
    - c. Identify wire types utilized for connection, interconnection with associate security subsystems.
    - d. Show device locations that correspond to the floor plans.
    - e. All general and drawing specific notes shall be included with the system drawings.
  5. A schedule for all of the applicable security subsystems shall be included. All schedules shall provide the following information:
    - a. Device ID.
    - b. Device Location (e.g. site, building, floor, room number, location, and description).
    - c. Mounting type (e.g. flush, wall, surface, etc.).
    - d. Power supply or circuit breaker and power panel number.
    - e. In addition, for the CCTV Systems, provide the camera ID, camera type (e.g. fixed or pan/tilt/zoom (P/T/Z), lens type (e.g. for fixed cameras only) and housing model number.
  6. Detail and elevation drawings for all devices that define how they were installed and mounted.
- E. Pre-installation design packages shall be reviewed by the Contractor along with a VA representative to ensure all work has been completed. All reviews shall be conducted in accordance with the project schedule. There shall be four (4) stages to the review process:
1. 35 percent
  2. 65 percent
  3. 90 percent
  4. 100 percent
- F. Provide manufacturer security system product cut-sheets. Submit for approval at least 30 days prior to commencement of formal testing, a Security System Operational Test Plan. Include procedures for operational testing of each component and security subsystem, to include performance of an integrated system test.
- G. Submit manufacture's certification of Underwriters Laboratories, Inc. (UL) listing as specified. Provide all maintenance and operating manuals per Section 01 00 00, GENERAL REQUIREMENTS.

#### **1.05 WARRANTY OF CONSTRUCTION.**

- A. Warrant PACMS work subject to the Article "Warranty of Construction" of FAR clause 52.246-21 and Section 280500.
- B. Demonstration and training shall be performed prior to system acceptance.

### **PART 2 – PRODUCTS**

#### **2.01 SYSTEM DATABASE**

- A. Database and database management software shall be HSPD-12 and FIPS compliant. Database and database management software shall define and modify each point in database using operator commands. Definition shall include parameters and constraints associated with each system device.
- B. Database Operations:
  1. System data management shall be in a hierarchical menu tree format, with navigation through expandable menu branches and manipulated with use of menus and icons in a

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- main menu and system toolbar.
  - 2. Navigational Aids:
    - a. Toolbar icons for add, delete, copy, print, capture image, activate, deactivate, and muster report.
    - b. Point and click feature to facilitate data manipulation.
    - c. Next and previous command buttons visible when editing database fields to facilitate navigation from one record to the next.
    - d. Copy command and copy tool in the toolbar to copy data from one record to create a new similar record.
  - 3. All data entry shall be automatically checked for duplicate and illegal data and shall verify that data are in a valid format.
  - 4. Provide a memo or note field for each item that is stored in database, allowing the storing of information about any defining characteristics of the item. Memo field is used for noting the purpose the item was entered for, reasons for changes that were made, and the like.
- C. File Management:
- 1. Provide database backup and restoration system, allowing selection of storage media, including hard discs, optical media, flash drives, and designated network resources.
  - 2. Provide manual and automatic mode of backup operations. The number of automatic sequential backups before the oldest backup becomes overwritten; FIFO mode shall be operator selectable.
  - 3. Backup program shall provide manual operation from any PC on the LAN and shall operate while system remains operational.
- D. Database Segmentation:
- 1. The System shall employ advanced database segmentation functionality. Each segment shall be allowed to have its own unique set of cardholders, hardware, and system parameters including access control field hardware, timezones, access levels, etc., which shall allow System Administrators to expand upon current hardware constraints. As such, only credentials that are assigned access levels to card readers in a segment need to be downloaded to the Data Gathering Panels in that segment.
  - 2. Cardholders shall be allowed to belong to one segment, many segments, or all segments.
  - 3. The database segmentation functionality shall also provide a capability to object records in the system, where segment System Administrators and Operators can only view, add, modify, delete, and manipulate cardholders, system parameters and access control field hardware that belong to their respective segments.
  - 4. System Administrators and System Operators shall be assigned the segments they are allowed to view and control. System Administrators and System Operators may be assigned to more than one segment and a segment may be assigned to more than one System Administrator and System Operator. A one-to-many relationship shall exist for System Administrators and System Operators with respect to segments. The SYSTEM shall support a minimum of [65,000] segments.
- E. Bi-Directional Data Exchange
- 1. The System shall support a real time, bi directional data interface to external databases such as Human Resources, Time and Attendance, Food Service Systems. The interface shall allow data to be imported into or exported out of the SYSTEM in real time or in a batch mode basis. Data used for import shall be retrieved directly from an external database or through an import file. Data provided for export shall be applied directly to an external database or through an export file. Any data shall be imported or exported including image data. The file used for import or created by export shall have the ability to be structured in a wide variety of ways, but shall always be in ASCII text format.
  - 2. The System shall also support a one step download and distribution process of cardholder and security information from the external database to the SYSTEM database, all the way down to the Intelligent Field Controller (ISC) database. This shall be a guaranteed process, even if the communication path between the SYSTEM database server and the

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ISC is broken. If the communication path is broken, the data shall be stored in a temporary queue and shall be automatically downloaded once the communication path is restored.

- F. Database connectivity:
1. The SMS database shall support open direct database connectivity for importing cardholder and card ID data from external systems and/or database applications. The PACS SMS shall facilitate interfacing by providing the following capabilities:
    - a. Real time and batch processing of data via ODBC, JDBC or OLE DB over a network connection.
    - b. Insert, update, and delete record information.
    - c. Automatic download of data to control panels (data gathering panels) based on database changes.
    - d. Provide audit trail in the operator history/archive database for all database changes initiated by the interface.
- G. Operator Passwords:
1. Software shall support up to [32,000] individual system operators, each with a unique password.
  2. Operator Password: [One to eight alphanumeric characters] .
  3. Allow passwords to be case sensitive.
  4. Allow use of Single sign-off (SSO) password.
  5. Passwords shall not be displayed when entered.
  6. Provide each password with a unique and customizable password profile, and allow several operators to share a password profile. Include the following features in the password profile:
    - a. Allow for at least [32,000] operator password profiles.
    - b. Predetermine the highest-level password profile for access to all functions and areas of program.
    - c. Allow or disallow operator access to any program operation, including the functions of View, Add, Edit, and Delete.
    - d. Restrict which doors an operator can assign access to.
  7. Operators shall use a user name and password to log on to system.
    - a. This user name and password is used to access database areas and programs as determined by the associated profile.
  8. Make provision to allow the operator to log off without fully exiting program. User may be logged off but program will remain running while displaying the login window for the next operator.
- H. Access Card/Code Operation and Management: Access authorization shall be by card /, by a manually entered code (PIN), by a combination of both (card plus PIN), by a biometric, by combination of PIN and biometric/.
1. Access authorization shall verify the card or card-and-PIN validation, and the access level (time of day, day of week, date), anti-passback status, and number of uses last.
  2. Use data-entry windows to view, edit, and issue access levels. Access authorization entry management system shall maintain and coordinate all access levels to prevent duplication or the incorrect creation of levels.
  3. Allow assignment of multiple cards/codes to a cardholder.
  4. Allow assignment of at least four access levels for each Location to a cardholder. Each access level may contain any combination of doors.
  5. Each door may be assigned four time zones.
  6. Access codes may be up to 11 digits in length.
  7. Software shall allow the grouping of locations so cardholder data can be shared by all locations in the group.
  8. Visitor Access: Issue a visitor badge, without assigning that person a card or code, for data tracking or photo ID purposes.

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9. Cardholder Tracing: Allow for selection of cardholder for tracing. Make a special audible and visual annunciation at control station when a selected card or code is used at a designated code reader. Annunciation shall include an automatic display of the cardholder image.
  - a. Allow option for each cardholder to be given either an unlimited number of uses or a number from 1 to 9998 that regulates the number of times the card can be used before it is automatically deactivated.
  - b. Provide for cards and codes to be activated and deactivated manually or automatically by date. Provide for multiple deactivate dates to be preprogrammed.
- I. Security Access Integration:
  1. Photo ID badging and photo verification shall use same database as the security access and may query data from cardholder, group, and other personal information to build a custom ID badge.
  2. The SMS shall provide a means for manually importing and exporting selected data in XML format. This mechanism shall support the import and export of any and all classes or types of data in the system. Specific data validation and logging requirements shall be met.
  3. The system shall also support importing from CSV files.
  4. The SMS shall provide an automated import mechanism (preferably XML-based). This mechanism shall support the import of most classes or types of data into the system. Specific data validation and logging requirements shall be met.
  5. The SMS shall provide a Data Mapping feature that provides field mapping information using the XSLT file based on the input data or an external XSLT file.
  6. Automatic or manual image recall and manual access based on photo verification shall also be a means of access verification and entry.
  7. System shall allow sorting of cardholders together by group or other characteristic for a fast and efficient method of reporting on, and enabling or disabling, cards or codes.
- J. Key control and tracking shall be an integrated function of cardholder data.
  1. Provide the ability to store information about which conventional metal keys are issued and to whom, along with key construction information.
  2. Reports shall be designed to list everyone that has possession of a specified key.
- K. Operator Comments:
  1. With the press of one appropriate button on toolbar, the user shall be permitted to make operator comments into history at anytime.
  2. Automatic prompting of operator comment shall occur before the resolution of each alarm.
  3. Operator comments shall be recorded by time, date, and operator number.
  4. Comments shall be sorted and viewed through reports and history.
  5. The operator may enter comments in two ways; either or both may be used:
    - a. Manually entered through keyboard data entry (typed), up to 65,000 characters per each alarm.
    - b. Predefined and stored in database for retrieval on request.
  6. System shall have a minimum of 999 predefined operator comments with up to 30 characters per comment.
- L. Group:
  1. Group names may be used to sort cardholders into groups that allow the operator to determine the tenant, vendor, contractor, department, division, or any other designation of a group to which the person belongs.
  2. System software shall have the capacity to assign 1 of 32,000 group names to an access authorization.
  3. Make provision in software to deactivate and reactivate all access authorizations assigned to a particular group.
  4. Allow sorting of history reports and code list printouts by group name.

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M. Time Zones:

1. Each zone consists of a start and stop time for 7 days of the week and three holiday schedules. A time zone is assigned to inputs, outputs, or access levels to determine when an input shall automatically arm or disarm, when an output automatically opens or secures, or when access authorization assigned to an access level will be denied or granted.
2. Up to four time zones may be assigned to inputs and outputs to allow up to four arm or disarm periods per day or four lock or unlock periods per day; up to three holiday override schedules may be assigned to a time zone.
3. Data-entry window shall display a dynamically linked bar graph showing active and inactive times for each day and holiday, as start and stop times are entered or edited.
4. System shall have the capacity for [2048] time zones for each Location.

N. Holidays:

1. Three different holiday schedules may be assigned to a time zone. Holiday schedule consists of date in format MM/DD/YYYY and a description. When the holiday date matches the current date of the time zone, the holiday schedule replaces the time zone schedule for that 24-hour period.
2. System shall have the capacity for [32,000] holidays.
3. Three separate holiday schedules may be applied to a time zone.
4. Holidays have an option to be designated as occurring on the designated date each year. These holidays remain in system and will not be purged.
5. Holidays not designated to occur each year shall be automatically purged from database after the date expires.

O. Access Levels:

1. System shall allow for the creation at least [32,000] access levels.
2. System shall allow for access to be restricted to any area by reader and by time. Access levels shall determine when and where an Identifier is authorized.
3. System shall be able to create multiple door and time zone combinations under same access level so that an Identifier may be valid during different time periods at different readers even if the readers are on the same Controller.

P. User-Defined Fields:

1. System shall provide a minimum of 99 user-defined fields, each with up to 50 characters, for specific information about each credential holder.
2. System shall accommodate a title for each field; field length shall be 20 characters.
3. A "Required" option may be applied to each user-defined field that, when selected, forces the operator to enter data in the user-defined field before the credential can be saved.
4. A "Unique" option may be applied to each user-defined field that, when selected, will not allow duplicate data from different credential holders to be entered.
5. Data format option may be assigned to each user-defined field that will require the data to be entered with certain character types in specific spots in the field entry window.
6. A user-defined field, if selected, will define the field as a deactivate date. The selection shall automatically cause the data to be formatted with the windows MM/DD/YYYY date format. The credential of the holder will be deactivated on that date.
7. A search function shall allow any one user-defined field or combination of user-defined fields to be searched to find the appropriate cardholder. The search function shall include search for a character string.
8. System shall have the ability to print cardholders based on and organized by the user-defined fields.

Q. Code Tracing:

1. System shall perform code tracing selectable by cardholder and by reader.
2. Any code may be designated as a "traced code" with no limit to how many codes can be traced.

3. Any reader may be designated as a "trace reader" with no limit to which or how many readers can be used for code tracing.
  4. When a traced code is used at a trace reader, the access-granted message that usually appears on the monitor window of the Central Station shall be highlighted with a different color than regular messages. A short singular beep shall occur at the same time the highlighted message is displayed on the window.
  5. The traced cardholder image (if image exists) shall appear on workstations when used at a trace reader.
- R. Database and File Replication:
1. The Security Management System shall be capable of supporting database and file replication using [Microsoft SQL Server Replication Services and Microsoft File Replication Services] for providing distributed database replication across multiple PACS application servers allowing for system expansion and delivering N tiers of server redundancy.
  2. Database and file replication shall not require any proprietary database or file replication software.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION**

- A. System installation shall be in accordance with manufacturer and related documents and references, for each type of security subsystem designed, engineered and installed.
- B. All software shall be installed per the design package and the manufacturer's installation specifications.

#### **3.02 TESTING AND TRAINING**

- A. All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.
- B. Perform testing and system certification as outlined in section 28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
- C. The software shall be entered into the SMS computer systems and debugged. The Contractor shall be responsible for documenting and entering the initial database into the system. The Contractor shall provide the necessary blank forms with instructions to fill in all the required data information that will make up the database. The database shall then be reviewed by the Contractor and entered into the system. Prior to full operation, a complete demonstration of the computer real time functions shall be performed. A printed validation log shall be provided as proof of operation for each software application package. In addition, a point utilization report shall be furnished listing each point, the associated programs utilizing that point as an input or output and the programs which that point initiates.
- D. Upon satisfactory on line operation of the system software, the entire installation including all subsystems shall be inspected. The Contractor shall perform all tests, furnish all test equipment and consumable supplies necessary and perform any work as required to establish performance levels for the system in accordance with the specifications. Each device shall be tested as a working component of the completed system. All system controls shall be inspected for proper operation and response.
- E. Tests shall demonstrate the response time and display format of each different type of input sensor and output control device. Response time shall be measured with the system functioning at full capacity. Computer operation shall be tested with the complete data file.
- F. The Contractor shall provide a competent trainer who has extensive experience on the installed systems and in delivering training to provide the instruction. As an alternative, the Contractor may propose the use of factory training personnel and coordinate the number of personnel to be trained.

**3.03 MAINTENANCE**

- A. The Contractor shall offer a Support Agreement (SSA) in order for Technical Support Specialists to reactively troubleshoot system problems.
- B. As part of the agreement, 5x9 telephone support (Standard and Enhanced SSA) will be provided to the Contractor by Certified Technicians. An option of 7x24 Standby telephone support (Enhanced SSA) shall be offered.
- C. As part of the agreement, Flashable and Non-Flashable (Chips) firmware and documentation shall be provided.
- D. As part of the agreement, access to Security Management System (SMS) software patches and software release updates shall be provided.
- E. The Support Agreement shall cover the current version of the SMS software release one full version back, and associated controller hardware.

**END OF SECTION**

**SECTION 281600  
INTRUSION DETECTION SYSTEM**

**PART 1 – GENERAL**

**1.01 DESCRIPTION**

- A. Provide and install a complete Intrusion Detection System, hereinafter referred to as IDS, as specified in this section.
- B. This Section includes the following:
  - 1. Intrusion detection with hard-wired or multiplexed, modular, microprocessor-based controls, intrusion sensors and detection devices, and communication links to perform monitoring, alarm, and control functions.
  - 2. Responsibility for integrating electronic and electrical systems and equipment is specified in the following Sections, with Work specified in this Section:
    - a. Division 08 Section "DOOR HARDWARE".
    - b. Division 27 Section "INTERCOMMUNICATIONS AND PROGRAM SYSTEMS".
    - c. Division 28 Section "PHYSICAL ACCESS CONTROL".
    - d. Division 28 Section "FIRE DETECTION AND ALARM".
    - e. Division 28 Section "VIDEO SURVEILLANCE".
    - f. Division 32 Section "CHAIN LINK FENCES AND GATES".
- C. Related Sections include the following:
  - 1. Division 28 Section "VIDEO SURVEILLANCE" for closed-circuit television cameras that are used as devices for video motion detection.
  - 2. Division 28 Section "CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY" for cabling between central-station control units and field-mounted devices and controllers.

**1.02 RELATED WORK**

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- B. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping application and use.
- C. Section 10 14 00 - SIGNAGE. Requirements for labeling and signs.
- D. Section 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS. Requirements for connection of high voltage.
- E. Section 26 05 21 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Requirements for power cables.
- F. Section 28 05 00 – COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. Requirements for general requirements that are common to more than one section in Division 28.
- G. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.
- H. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.
- I. Section 28 05 28.33 - CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.
- J. Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY. Requirements for commissioning - systems readiness checklists, and training.
- K. Section 28 13 00 - PHYSICAL ACCESS CONTROL SYSTEMS (PACS). Requirements for physical access control integration.
- L. Section 28 13 16 - ACCESS CONTROL SYSTEM AND DATABASE MANAGEMENT. Requirements for control and operation of all security systems.



- M. Section 28 23 00 - VIDEO SURVEILLANCE. Requirements for security camera systems.
- N. Section 28 26 00 - ELECTRONIC PERSONAL PROTECTION SYSTEM (EPPS). Requirements for emergency and interior communications.

### 1.03 QUALITY ASSURANCE

- A. The Contractor shall be responsible for providing, installing, and the operation of the IDS as shown. The Contractor shall also provide certification as required.
- B. The security system shall be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the security system is stand-alone or a part of a complete Information Technology (IT) computer network.
- C. The Contractor or security sub-contractor shall be a licensed security Contractor as required within the state or jurisdiction of where the installation work is being conducted.

### 1.04 DEFINITIONS

- A. Controller: An intelligent peripheral control unit that uses a computer for controlling its operation. Where this term is presented with an initial capital letter, this definition applies.
- B. I/O: Input/Output.
- C. Intrusion Zone: A space or area for which an intrusion must be detected and uniquely identified, the sensor or group of sensors assigned to perform the detection, and any interface equipment between sensors and communication link to central-station control unit.
- D. LED: Light-emitting diode.
- E. NEC: National Electric Code
- F. NEMA: National Electrical Manufacturers Association
- G. NFPA: National Fire Protection Association
- H. NRTL: Nationally Recognized Testing Laboratory.
- I. SMS: Security Management System – A SMS is software that incorporates multiple security subsystems (e.g., physical access control, intrusion detection, closed circuit television, intercom) into a single platform and graphical user interface.
- J. PIR: Passive infrared.
- K. RF: Radio frequency.
- L. Standard Intruder: A person who weighs 45 kg (100 lb.) or less and whose height is 1525 mm (60 in) or less; dressed in a long-sleeved shirt, slacks, and shoes.
- M. Standard-Intruder Movement: Any movement, such as walking, running, crawling, rolling, or jumping, of a "standard intruder" in a protected zone.
- N. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
- O. UPS: Uninterruptible Power Supply
- P. UTP: Unshielded Twisted Pair

### 1.05 SUBMITTALS

- A. Submit below items in conjunction with Master Specification Sections 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and Section 02 41 00, DEMOLITION.
- B. Provide certificates of compliance with Section 1.3, Quality Assurance.
- C. Provide a shop drawing and as-built design package in both electronic format and on paper, minimum size 1220 x 1220 millimeters (48 x 48 inches); drawing submittals shall be per the established project schedule.
- D. Shop drawing and as-built packages shall include, but not be limited to:

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1. Index Sheet that shall:
    - a. Define each page of the design package to include facility name, building name, floor, and sheet number.
    - b. Provide a list of all security abbreviations and symbols.
    - c. Reference all general notes that are utilized within the design package.
    - d. Specification and scope of work pages for all security systems that are applicable to the design package that will:
      - 1) Outline all general and job specific work required within the design package.
      - 2) Provide a device identification table outlining device Identification (ID) and use for all security systems equipment utilized in the design package.
  2. Drawing sheets that will be plotted on the individual floor plans or site plans shall:
    - a. Include a title block as defined above.
    - b. Define the drawings scale in both standard and metric measurements.
    - c. Provide device identification and location.
    - d. Address all signal and power conduit runs and sizes that are associated with the design of the electronic security system and other security elements (e.g., barriers, etc.).
    - e. Identify all pull box and conduit locations, sizes, and fill capacities.
    - f. Address all general and drawing specific notes for a particular drawing sheet.
  3. A riser drawing for each applicable security subsystem shall:
    - a. Indicate the sequence of operation.
    - b. Relationship of integrated components on one diagram.
    - c. Include the number, size, identification, and maximum lengths of interconnecting wires.
    - d. Wire/cable types shall be defined by a wire and cable schedule. The schedule shall utilize a lettering system that will correspond to the wire/cable it represents (example: A = 18 AWG/1 Pair Twisted, Unshielded). This schedule shall also provide the manufacturer's name and part number for the wire/cable being installed.
  4. A system drawing for each applicable security system shall:
    - a. Identify how all equipment within the system, from main panel to device, shall be laid out and connected.
    - b. Provide full detail of all system components wiring from point-to-point.
    - c. Identify wire types utilized for connection, interconnection with associate security subsystems.
    - d. Show device locations that correspond to the floor plans.
    - e. All general and drawing specific notes shall be included with the system drawings.
  5. A schedule for all of the applicable security subsystems shall be included. All schedules shall provide the following information:
    - a. Device ID.
    - b. Device Location (e.g. site, building, floor, room number, location, and description).
    - c. Mounting type (e.g. flush, wall, surface, etc.).
    - d. Power supply or circuit breaker and power panel number.
    - e. In addition, for the IDS, provide the sensor ID, sensor type and housing model number.
  6. Detail and elevation drawings for all devices that define how they were installed and mounted.
- E. Shop drawing packages shall be reviewed by the Contractor along with a VA representative to ensure all work has been clearly defined and completed. All reviews shall be conducted in accordance with the project schedule. There shall be four (4) stages to the review process:
1. 35 percent
  2. 65 percent
  3. 90 percent

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4. 100 percent
- F. Provide manufacturer security system product cut-sheets. Submit for approval at least 30 days prior to commencement of formal testing, a Security System Operational Test Plan. Include procedures for operational testing of each component and security subsystem, to include performance of an integrated system test.
- G. Submit manufacture's certification of Underwriters Laboratories, Inc. (UL) listing as specified. Provide all maintenance and operating manuals per the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.
- H. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

**1.06 APPLICABLE PUBLICATIONS**

- A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI)/Security Industry Association (SIA):
  1. PIR-01-00 - Passive Infrared Motion Detector Standard - Features for Enhancing False Alarm Immunity
  2. CP-01-00 - Control Panel Standard-Features for False Alarm Reduction
- C. Department of Justice American Disability Act (ADA)
  1. 28 CFR Part 36 - 2010 ADA Standards for Accessible Design
- D. Federal Communications Commission (FCC):
  1. (47 CFR 15) Part 15 - Limitations on the Use of Wireless Equipment/Systems
- E. National Electrical Manufacturers Association (NEMA):
  1. 250-08 - Enclosures for Electrical Equipment (1000 Volts Maximum)
- F. National Fire Protection Association (NFPA):
  1. 70-11 - National Electrical Code
  2. 731-08 - Standards for the Installation of Electric Premises Security Systems
- G. Underwriters Laboratories, Inc. (UL):
  1. 464-09 - Audible Signal Appliances
  2. 609-96 - Local Burglar Alarm Units and Systems
  3. 634-07 - Standards for Connectors with Burglar-Alarm Systems
  4. 639-07 - Standards for Intrusion Detection Units
  5. 1037-09 - Standard for Anti-theft Alarms and Devices
  6. 1037-10 - Digital Alarm Communicator System Units
- H. Uniform Federal Accessibility Standards (UFAS), 19841.

**1.07 COORDINATION**

- A. A. Coordinate arrangement, mounting, and support of intrusion detection system equipment:
  1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  3. To allow right of way for piping and conduit installed at required slope.
  4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

- C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed.

#### **1.08 EQUIPMENT AND MATERIALS**

- A. General
  - 1. All equipment associated within the IDS shall be rated for continuous operation. Environmental conditions (i.e. temperature, humidity, wind, and seismic activity) shall be taken under consideration at each facility and site location prior to installation of the equipment.
  - 2. All equipment shall operate on a 120 or 240 volts alternating current (VAC); 50 Hz or 60 Hz AC power system unless documented otherwise in subsequent sections listed within this specification. All equipment shall have a back-up source of power that will provide a minimum of 96 hours of run time in the event of a loss of primary power to the facility.
  - 3. The system shall be designed, installed, and programmed in a manner that will allow for ease of operation, programming, servicing, maintenance, testing, and upgrading of the system.
  - 4. All IDS components located in designated "HAZARDOUS ENVIRONMENT" areas where fire or explosion could occur due to the presence of natural gases or vapors, flammable liquids, combustible residue, or ignitable fibers or debris, shall be rated Class II, Division I, Group F, and installed in accordance with National Fire Protection Association (NFPA) 70 National Electric Code, Chapter 5.
  - 5. All equipment and materials for the system will be compatible to ensure functional operation in accordance with requirements.

#### **1.09 WARRANTY OF CONSTRUCTION.**

- A. Warrant IDS work subject to the Article "Warranty of Construction" of FAR 52.246-21.
- B. Demonstration and training shall be performed prior to system acceptance.

### **PART 2 – PRODUCTS**

#### **2.01 FUNCTIONAL DESCRIPTION OF SYSTEM**

- A. Supervision: System components shall be continuously monitored for normal, alarm, supervisory, and trouble conditions. Indicate deviations from normal conditions at any location in system. Indication includes identification of device or circuit in which deviation has occurred and whether deviation is an alarm or malfunction.
  - 1. Alarm Signal: Display at central-station control unit and actuate audible and visual alarm devices.
  - 2. Trouble Condition Signal: Distinct from other signals, indicating that system is not fully functional. Trouble signal shall indicate system problems such as battery failure, open or shorted transmission line conductors, or controller failure.
  - 3. Supervisory Condition Signal: Distinct from other signals, indicating an abnormal condition as specified for the particular device or controller.
- B. System Control: Central-station control unit shall directly monitor intrusion detection units and connecting wiring.
- C. System shall automatically reboot program without error or loss of status or alarm data after any system disturbance.
- D. Operator Commands:
  - 1. Help with System Operation: Display all commands available to operator. Help command, followed by a specific command, shall produce a short explanation of the purpose, use, and system reaction to that command.
  - 2. Acknowledge Alarm: To indicate that alarm message has been observed by operator.
  - 3. Place Protected Zone in Access: Disable all intrusion-alarm circuits of a specific protected zone. Tamper circuits may not be disabled by operator.
  - 4. Place Protected Zone in Secure: Activate all intrusion-alarm circuits of a protected zone.

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5. Protected Zone Test: Initiate operational test of a specific protected zone.
  6. System Test: Initiate system-wide operational test.
  7. Print Reports.
- E. Timed Control at Central-Station Control Unit: Allow automatically timed "secure" and "access" functions of selected protected zones.
- F. Automatic Control of Related Systems: Alarm or supervisory signals from certain intrusion detection devices control the following functions in related systems:
1. Switch selected lights.
  2. Open a signal path between certain intercommunication stations.
  3. Shift sound system to "listening mode" and open a signal path to certain system speakers.
  4. Switch signal to selected monitor from closed-circuit television camera in vicinity of sensor signaling an alarm.
- G. Response Time: 2 seconds between actuation of any alarm and its indication at central-station control unit.
- H. Circuit Supervision: Supervise all signal and data transmission lines, links with other systems, and sensors from central-station control unit. Indicate circuit and detection device faults with both protected zone and trouble signals, sound a distinctive audible tone, and illuminate an LED. Maximum permissible elapsed time between occurrence of a trouble condition and indication at central-station control unit is 20 seconds. Initiate an alarm in response to opening, closing, shorting, or grounding of a signal or data transmission line.
- I. Programmed Secure-Access Control: System shall be programmable to automatically change status of various combinations of protected zones between secure and access conditions at scheduled times. Status changes may be preset for repetitive, daily, and weekly; specially scheduled operations may be preset up to a year in advance. Manual secure-access control stations shall override programmed settings.
- J. Manual Secure-Access Control: Coded entries at manual stations shall change status of associated protected zone between secure and access conditions.

## **2.02 SYSTEM COMPONENT REQUIREMENTS**

- A. Compatibility: Detection devices and their communication features, connecting wiring, and central-station control unit shall be selected and configured with accessories for full compatibility with the following equipment:
1. Data Gathering Panel, Output Module, Input Module, 28 13 00 PHYSICAL ACCESS CONTROL SYSTEM.
- B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.
1. Minimum Protection for Power Lines 120 V and More: Auxiliary panel suppressors complying with requirements in Division 26 Section TRANSIENT-VOLTAGE SUPPRESSION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS.
  2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Comply with requirements in Division 26 Section TRANSIENT-VOLTAGE SUPPRESSION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS as recommended by manufacturer for type of line being protected.
- C. Interference Protection: Components shall be unaffected by radiated RFI and electrical induction of 15 V/m over a frequency range of 10 to 10,000 MHz and conducted interference signals up to 0.25-V RMS injected into power supply lines at 10 to 10,000 MHz.
- D. Tamper Protection: Tamper switches on detection devices, controllers, annunciators, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled and when entering conductors are cut or disconnected. Central-station control-unit alarm display shall identify tamper alarms and

indicate locations.

- E. Self-Testing Devices: Automatically test themselves periodically, but not less than once per hour, to verify normal device functioning and alarm initiation capability. Devices transmit test failure to central-station control unit.
- F. Antimasking Devices: Automatically check operation continuously or at intervals of a minute or less, and use signal-processing logic to detect blocking, masking, jamming, tampering, or other operational dysfunction. Devices transmit detection of operational dysfunction to central-station control unit as an alarm signal.
- G. Addressable Devices: Transmitter and receivers shall communicate unique device identification and status reports to central-station control unit.
- H. Remote-Controlled Devices: Individually and remotely adjustable for sensitivity and individually monitored at central-station control unit for calibration, sensitivity, and alarm condition.

### **2.03 ENCLOSURES**

- A. Interior Sensors: Enclosures that protect against dust, falling dirt, and dripping noncorrosive liquids.
- B. Interior Electronics: NEMA 250, Type 12.
- C. Exterior Electronics: NEMA 250, Type 4X [fiberglass] [stainless steel].
- D. Corrosion Resistant: NEMA 250, Type 4X [PVC] [stainless steel].
- E. Screw Covers: Where enclosures are accessible to inmates, secure with security fasteners of type appropriate for enclosure.

### **2.04 EQUIPMENT ITEMS**

- A. General:
  - 1. All requirements listed below are the minimum specifications that need to be met in order to comply with the IDS.
  - 2. All IDS sensors shall conform to UL 639, Intrusion Detection Standard.
  - 3. Ensure that IDS is fully integrated with other security subsystems as required to include, but not limited to, the CCTV, PACS, EPPS, and Physical Access Control System and Database Management. The IDS provided shall not limit the expansion and growth capability to a single manufacturer and shall allow modular expansion with minimal equipment modifications.
- B. IDS Components: The IDS shall consist of, but not be limited to, the following components:
  - 1. Control Panel
  - 2. Exterior Detection Devices (Sensors)
  - 3. Interior Detection Devices (Sensors)
  - 4. Power Supply
  - 5. Enclosures

### **2.05 CONTROL PANEL**

- A. The Control panel shall be the main point of programming, monitoring, accessing, securing, and troubleshooting the IDS. Refer to American National Standards Institute (ANSI) CP-01 Control Panel Standard-Features for False Alarm Reduction.
- B. The Control Panel shall provide a means of reporting alarms to an Physical Access Control System and Database Management via a computer interface or direct connection to an alarm control monitoring panel.
- C. The Control panel shall utilize a Multifunctional Keypad, Input and Output Modules for expansion of alarm zones, interfacing with additional security subsystems, programming, monitoring and controlling the IDS.

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D. The Control panel shall meet or exceed the following minimum functional requirements for programming outputs, system response, and user interface:

1. Programming Outputs:
  - a. 2 Amps alarm power at 12 VDC
  - b. 1.4 Amps auxiliary power at 12 VDC
  - c. Four alarm output patterns
  - d. Programmable bell test
  - e. Programmable bell shut-off timer
2. System Response:
  - a. Selectable point response time
  - b. Cross point capability
  - c. Alarm verification
  - d. Watch mode
  - e. Scheduled events arm, disarm, bypass and un-bypass points, control relays, and control authority levels
3. User Interface:
  - a. Supervises up to eight command points (e.g. Up to 16 unsupervised keypads can be used)
  - b. Provides custom keypad text
  - c. Addresses full function command menu including custom functions
  - d. Allows user authority by defined area and 16-character name
  - e. Provides for 14 custom authority control levels allowing user's authority to change, add, delete pass codes, disarm, bypass points, and start system tests.

4. The Control panel shall meet or exceed the following technical characteristics:

Input Voltage via 110 VAC or 220 VAC Step-down Transformer	16 or 18 VAC
Operating Voltage	12 VDC
Output Voltage	12 VDC @ 2 A max
Direct Hardwire Zones	7
Partitions	8
Multifunctional Keypads	16 (2 per partition)
Communications Port	RJ-11

E. A multifunctional keypad shall be utilized as a user interface for arming, disarming, monitoring, troubleshooting, and programming the alarm control panel.

F. Keypads shall have the following features:

1. Multiple function keypads suitable for remote mounting, no greater than 1333 m (4000 ft), shall be provided from the control panel and have a light emitting diode (LED) readout of alarm and trouble conditions by zone.
2. An alphanumeric English language display, with keypad programmability, and EE-PROM memory, shall also be provided.
3. Trouble alarm indicators shall be distinguishable from intrusion alarms.
4. A minimum of four (4) zones selectable as entry and exit with programmable time delay.
5. Complete system test activated capability at the keypad.
6. Capability for opening and closing reports to a remote monitoring location.
7. Adjustable entry and exit delay times.
8. Capability for a minimum of two (2) multiple function keypads.
9. Capability to shunt or bypass selected interior zones while arming perimeter protection and remaining interior zones.
10. Capability for a minimum of seven assignable pass-codes that are keypad programmable from a suppressed master code.

11. The control panel shall have a communications port that will allow for communications with a computer for programming, monitoring, and troubleshooting purposes. The communications port will be, at a minimum, and RJ-11 or better.
12. The control panel will have a systems success probability of 95% or better, and shall include the following success considerations:
  - a. False Alarm: Shall not exceed one (1) false alarm per 30 days per sensor zone.
  - b. Nuisance Alarm: Shall not exceed a rate of one (1) alarm per seven (7) days per zone within the first 60 days after installation and acceptance. Sensor adjustments will be made and then shall not exceed one (1) alarm per 30 days.
13. The Control Panel will be able to detect either a line fault or power loss for all supervised data cables.
  - a. Line Fault Detection: Communication links of the IDS shall have an active mode for line fault detection. Fault isolation at the systems level shall have the same geographic resolutions as provided for intrusion detection. The line fault alarm shall be clearly distinguishable from other alarms.
  - b. Power Loss Detection: Provide the capability to detect when critical components experience temporary or permanent loss of power and annunciate to clearly identify the component experiencing power loss.

**2.06 KEYPADS**

- A. Keypads shall meet or exceed the following technical characteristics:

Connections	4-wire flying lead for data and power
Operating Temperature	0°C to +50°C (+32°F to +122°F)
Display Window	8-point LED
Indicators: Illuminated keys	Armed Status-LED
	Point Status-LED
	Command Mode-LED
	Power-LED
Voltage	Nominal 12 VDC

**2.07 INPUT MODULE**

- A. An input module shall be utilized to connect additional detection devices to the control panel. This module will meet or exceed the following technical characteristics:

Operating Voltage	8.5 to 14.5 VDC Nominal
Zone Inputs	Style A (Class B) Supervised
Operating Temperature	0 to 40 degrees C (32 to 140 degrees F)

**2.08 OUTPUT MODULE**

- A. An output module shall be utilized to interface the control panel with other security subsystems. The output module shall meet or exceed the following technical characteristics:

Operating Voltage	8.5 to 14.5 VDC Nominal
Output Relays	“Form C” Dry Relay Contracts
Relay Contact Rating	4A @ 24 VDC
	4A @ 24 VAC
	1A @ 70 VAC
Operating Temperature	0 to 40 degrees C F (32 to 140 degrees)

**2.09 EXTERIOR DETECTION DEVICES (SENSORS)**

- A. The IDS shall consist of interior, exterior, and other detection devices that are capable of:
1. Locating intrusions at individually protected asset areas or at an individual portal;
  2. Locating intrusions within a specific area of coverage;



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3. Locating failures or tampering of individual sensors or components.
- B. Audible annunciation shall meet UL 464 Audible Signal Appliance requirements as well as other stated within this specification. IDS shall provide and adjust for devices so that coverage is maximized in the space or area it is installed in. For large areas where multiple devices are required, ensure exterior device coverage is overlapping.
- C. Detection sensitivity shall be set up to ensure maximum coverage of the secure area is obtained while at the same time limiting excessive false alarms due to the environment and impact of small animals. All detection devices shall be anti-masking with exception of video motion detection.
- D. Dual sensor technology shall be used when possible. Sensor technology shall not be of the same type that is easily defeated by a single method. This will reduce the amount of false alarms.
- E. Exterior sensors described in this section are intended for outdoor use for perimeter and fence control monitoring purposes. Some sensors described in the interior sensor section may be utilized that can provide both outdoor and indoor protection.

F. External Sensors Environmental Characteristics:

Temperature	-25°F - 140°F (-32°C - 60°C)
Pressure	Sea Level to 15,000 ft. (4573m) above sea level
Solar Radiation	Six (6) hrs. exposure at dry bulb temp. 120°F (60°C)
Rain	Two (2) in. (50 mm) per hour
Humidity	5% - 95%
Fungus	Components of non-fungus nutrient materials
Salt/fog	Atmosphere 5% salinity
Snow loading	48 lbs per sq. ft. (234 kg per sq. meter)
Ice accumulation	Up to ½ in. (12.7 mm) radial ice
Wind limitations	50 mph (80 km/h) Gusts to 66 mph (106 km/h)
Acoustical Noise Suitability	> 110 decibels (dB)

G. Electromechanical Fence Sensors

1. Electromechanical Fence Sensors: Shall sense mechanical vibrations or motion associated with scaling, cutting, or attempting to lift standard security chain link fence as follows: Note: Dead zones shall not exist from a monitoring and alarm coverage perspective.
2. The sensor zone control unit shall alarm when a sufficient number of sensing unit activations surface within a specified time period.
3. Individual sensing units and the alarm thresholds shall be field adjustable (i.e., performed by an authorized technician or trained maintenance personnel). Midrange sensitivity settings shall alarm a sensor when an intruder attempts to scale or climb the fence in areas of reduced sensitivity (e.g. around poles and rigid supports, etc.) and attempted lifting or scaling of a fence, including using assisted methods (e.g. items leaned against the fence, etc.) occur. Sensors shall allow gradual changes in fence positioning due to expansion, settling, and aging, without increased numbers of nuisance alarms taking place.
4. Exterior sensor components shall be housed in rugged, corrosion-resistant enclosures, protected from environmental impact and degradation.

5. Fence cable support hardware shall be weather-resistant. Interfacing between sensor zones and alarm enunciators, require they be installed in underground conduit and cables.
6. Fencing Cable Technical Characteristics:

Input voltage	12-30 V DC
Current requirement	4 mA quiescent 25 mA (max) in alarm
Transient suppression	On data, power input lines and on relay output
Enclosure	Weatherproof
Sensor type	Inertial band-pass-filter
Transponder	4 zone controller Output relays for dry contacts, or RS-485 communication Inputs for weather sensor
Sensor spacing	2.5 to 3 m (8.2 to 9.9 ft.)
Data I/O	RS 485 communications
Data output	<ul style="list-style-type: none"> <li>• Vibration alarm (in either line)</li> <li>• Line alarm (in either line)</li> <li>• End of line action</li> <li>• Wind situation</li> <li>• Weather sensor line failure</li> <li>• Enclosure tamper switch</li> <li>• Program fail</li> <li>• A dry contact output with end of line resistor per each of 4 vibration inputs</li> </ul>

H. Strain Sensitive Cable Sensors

1. Strain-Sensitive Cable Sensors: These devices shall detect movement on a standard security chain link fence associated with an intruder scaling, cutting through, or attempting to lift the fence fabric. The entire sensor system shall be mounted directly on the fence and able to withstand the same environmental condition exposures. Note: The length of the fence shall also maintain no sensor monitoring dead zones.
  - a. Individual sensing units and the alarm threshold shall be field adjustable (i.e. by authorized technicians or trained maintenance personnel) for compensation of winds up to 40km/h (25 mph) or by zone without increased nuisance alarms while maintaining specified sensor performance as under ambient conditions.
  - b. Sensor zone control units shall provide an analog audio output for interface to an external audio amplifier to permit remote audio assessment regardless of sensor alarm status. The sensor zone control unit alarm output interface shall be a separately supervised relay contact normally open or normally closed.
  - c. The length of the fence shall be divided into 100m (300 ft) zones.
  - d. The sensing unit shall consist of transducer cable capable of achieving specified performance either by attachment directly to the fence fabric by plastic cable every 300 to 455 mm (12 to 18 inches) or by installation inside electrical metallic tubing conduit mounted on the fence.
  - e. The sensing unit shall have equal adjustable sensitivity throughout the entire fence length. Only conventional waterproof coaxial cable connectors shall be used for connections of the sensing unit to avoid electrical magnetic interference.
  - f. The entire sensor system shall be tamper resistant and capable of detecting tampering within each portion of the system by sensor zone.

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g. Magnetic Sensor Cable Technical Characteristics:

Magnetic Sensor Cable	
Type cable	Four (4) conductor magnetically loaded, aluminum foil shield and ground wire
Maximum zone length	300 m (1000 ft.)
Life expectancy	10 years
Sensitivity	Uniform over length of cable
Audio Bandwidth	Five (5) kHz
Outer Cover	Black Polyurethane, Ultraviolet resistant
Insensitive Cable (remote processing)	
Type cable	2 twisted pair, individually sealed
Outer Cover	Black Polyurethane, Ultraviolet resistant
Dual Channel Signal Processor	
Input Power	10.2 – 13.8 VDC 65 mA
Alarm Output	Alarm contacts SPNC 0.75 mA, 200 VDC
Indicators	Three (3): Alarm, tamper, events
Cut processor	Sensitivity - 10 settings Time window – 0.5 – 4.5 min Event Counter – nine (9)
Climb processor	Sensitivity – 10 settings

I. Buried Electromagnetic Cable Sensor

1. The system shall be able to function as a standalone system or as an integral component of a centralized security control system.
2. The detection field shall be formed by radio-frequency (RF) signals carried by sensor cables that are buried along the perimeter.
3. The RF signals shall form an invisible electromagnetic detection field around the sensor cables that can detect the presence of an intruder passing through the field.
4. The system shall detect moving intruders that have a significant electromagnetic field (e.g. humans, vehicles, and other large conductive objects) while rejecting other environmental stimuli such as birds, small animals, weather elements.
5. A sensor module shall contain the electronics required to:
  - a. Transmit and receive the RF signal without the use of an external antenna.
  - b. Monitor the detection fields of two (2) zones and produce an alarm when an intruder enters the zones.
6. Field power modules shall be available for standalone systems and networked systems.
7. As a standalone system, the primary operator interface shall be a local interface module that is connected directly to the sensor module.
8. As part of a network configuration, the primary operator interface shall be a personal computer (PC) based central controller. The central controller shall monitor the performance of the entire buried coaxial cable outdoor intrusion detection system and any auxiliary sensors. The central controller shall have the capability of acknowledging, processing and reporting alarms. A customized color site map that is displayed on the PC monitor shall be an available option for the system to monitor sensor locations.
9. Transmission and reception shall be accomplished without the use of antennae. The RF signal shall be monitored and analyzed by the sensor module for any changes in the detection field properties that would indicate the presence of an intruder.
10. Alarms generated by internal electronic processes (cables excluded) shall not exceed one (1) per zone per month. System generated alarms are averaged based on the total number of zones in the system.

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11. When the system is calibrated in accordance with the manufacturers' recommendations, the detection field shall be continuous and uniform over the protected site perimeter.
12. When system sensitivity is calibrated according to manufacturers' recommendations, the detection field shall not detect a valid target that is a minimum of 2 m. (6.5 ft) from the nearest sensor cable.

13. Buried Electromagnetic Cable Sensor Technical Characteristics:

Burial Medium	Clay, sand, soil, asphalt, concrete
Snow limitation	Up to 30c. (1 foot) deep
Degradation Guaranty	Minimum 10 yr.
Detection Medium	Radio Frequency (RF)
Detection Coverage	Maximum 200m (656 ft.) per zone
Detection Capability	Human: >34 kg. (75 lbs)
Detection Speed	Human walk, crawl, run, roll, jump 2.5 cm/sec (1 in./sec.) –15 m/sec (50 ft./sec.) regardless of direction across field
Velocity Response	Programmable
Detection Probability	Human: 99% with 95% confidence factor Animal: Less than 10 kg. (22 lbs.) Less than 5% with 90% confidence factor
Terrain Detection Capabilities	Even to uneven ground with maximum (max) grade 4 m (13 ft.) Corner bend radius 6.5m (22 ft.)
Detection Field Cross Section	Upright walking; Height 1m: (3.2 ft.) above ground Width: 2m (6.5 ft.) single cable 3m. (9.75 ft) double cable
Sensing Element	Ported (leaky) coaxial cables
Cable Construction	Abrasion and chemical resistant, high density polyethylene, with flooding compound
Cable Requirements	Two (2): Transmit cable, receive cable
Configurations Available	Two (2): Single cable, double cable
Cable Lengths	50 m (164 ft.), 100 m (328 ft.), 150 m (492 ft.), 200 m (656 ft.)
Zone Length Minimum	10 m (33 ft.)
Antenna Requirements	None
False alarm rate	Less than one (1) per day

14. Sensor Module: Each sensor module shall transmit, receive and process the electromagnetic detection fields independently from other sensor modules. Failure of one (1) sensor module shall not affect the remainder of the perimeter. The sensor module shall operate as either a standalone unit, or in a network configuration in conjunction with a central controller. The sensor module shall be mounted in a weatherproof enclosure when installed outdoors as follows.
  - a. The sensor module shall use an adaptive filter to analyze the detection signal and adjust the signal processing to reduce nuisance alarms caused by environmental factors such as rainfall or slow-running water.

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- b. The sensor module shall identify, by type, sensor, tamper, and failure alarms either locally at the sensor module, or centrally at a central controller. The sensor cables shall provide the data paths between the sensor modules, for the transmission, reception and display of alarm conditions.
- c. Each sensor module shall include an internal interface for the collection of auxiliary sensor data.
- d. It shall be possible to supply power directly to each unit for applications that require either a single sensor module or multiple sensor modules with independent power sources.
- e. The sensor module's response shall be demonstrated by an analog output signal that can be displayed on a voltmeter or on an analog voltage-recording device. The output signal shall be encoded to indicate the alarm trip-point, thereby showing the sensor module's degree of detection above or below the level required to cause an alarm.
- f. Sensor Module Technical Characteristics:

Sensor Module Power Output	12 VDC at 150 milliampere (mA)
Sensor Module Power Requirements	Stand-alone: 12 VDC 500 mA max Network: 48 VDC 175 mA max
Sensor capability	Two (2) zones independent of other sensor modules
Sensor coverage	400 m. (1,312 ft)
Calibration	Locally and remotely from Central Controller
Self Test	Via 4 relay drive points
Detection coverage	Unlimited expansion using multiple modules
Nuisance avoidance	Adaptive filtering
Connectivity	RS-485 twisted pair cable
Sensor Support	Dual redundant data paths
Transmission capability	Eight (8) contact-closure signals

- g. The field power module shall be capable of supplying power to sensor modules as follows:
  - 1) In a network configuration where power is supplied redundantly via the sensor cables, the sensor modules shall operate within specifications when power is removed from either of the two (2) sensor cables.
  - 2) Each cable zone shall be capable of being calibrated either locally at the sensor module, or remotely from a central controller. Additional signal processing parameters, including high speed and low speed response, shall be capable of being set from a central controller.
  - 3) Detection sensitivity for each zone shall be adjusted either locally at the sensor module with a local interface module, or from a central controller. Access to the local calibration controls shall require the removal of the enclosure's cover and shall cause a tamper alarm to be generated.
  - 4) Power Module Technical Characteristics:

Output support	Nine (9) sensor modules max 2,800 m (3,063 yards)
System block configuration	1,400 m (1,531 yds.)
Power Output	Stand-alone: 12 VDC 500 mA max Network: 48 VDC 175 mA max

J. Microwave Sensors

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1. The system shall be a modular microwave outdoor intrusion detection sensor based on microwave radar technology. The detection field shall be formed by radio frequency (RF) signals, in the X-band, carried between a transmitter and a receiver. The RF signals shall form an invisible electromagnetic detection field that can detect the presence of an intruder who walks, crawls, rolls, jumps, or runs through a detection field as follows.
  - a. Transmitter shall create the RF signals that form the detection field. A receiver shall house the necessary electronics to monitor the detection field and to raise an alarm when an intruder enters the field. The transmitter and receiver shall be powered individually, as a standalone unit.
  - b. An electromagnetic wave is emitted by the antenna of the transmitter and received by the antenna of the receiver. The receiver shall detect changes that are caused by the presence of an intruder.
  - c. The system shall detect moving intruders having a significant electromagnetic cross-section (e.g. humans, vehicles, and other large conductive objects) rejecting other environmental stimuli.
  - d. The system shall be capable of detecting human intruders moving through the detection field regardless of the direction of motion.
  - e. Processor description: The receiver shall contain the necessary electronics to perform the signal processing for the detection zone. The transmitter and receiver shall be operated as a standalone unit with independent power and data. Both the transmitter and receiver shall be installed in weatherproof enclosures.
  - f. Distributed processing: Transmitter-receiver pairs distributed along a perimeter shall provide extended range and fail-safe operation. The failure of one (1) pair shall not affect the coverage of the remainder of the perimeter.
  - g. Alarms: The signal processor shall identify intrusion and tamper/fail alarms locally, at the transmitter or receiver.
    - 1) An alarm caused by opening the outer enclosure of the transmitter or receiver shall be identified as a tamper alarm. Tamper alarms shall be distinctive from intrusion alarms.
    - 2) Alarms caused by power failure or internal electronic failure are fail alarms, distinctive from intrusion alarms.
  - h. Microwave Sensor System Technical Characteristics:

Operating voltage Transmitter	11 – 15 VDC 70mA max. current
Operating voltage Receiver	11 – 15 VDC 30mA max. current
Operating Environment	–30°C (-22F) and 60°C (140 F)
LEDs	POWER ON, WRONG CHANNEL, ALARM
Maximum zone length	10 m (33 ft.) and a maximum of 457 m (1500 ft.) per zone.
Detection Success Probability	34 kg (75 lbs.) 99% with a 95% confidence factor
Operating frequency	X Band 10.525 □ 0.025 gigahertz (GHz)
Type modulation	Class A2 with one (1) of six (6) selectable crystal-controlled frequencies.
Detection movement speed	5 cm/sec. (2.0 in. sec.) to 8 m/sec. (26 ft. sec.)
Audio assessment	Via 1/8 in. phone jack on receiver
Alarms	Tamper, failure, intrusion
Tamper/fail alarm	Via sealed relay rated one (1) ampere 28

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	VDC
Intrusion field alarm	Via sealed relay rated two (2) ampere 28 VDC.
Intrusion alarm latch time	Adjustable: 0.5 sec and 10 sec
Processing	Distributed: receiver/transmitter pairs
Perimeter Length	Single Receiver/transmitter pair: 457 m (1500 ft.)
	Multiple pairs: Unlimited

K. Taut-Wire Sensors

1. These sensors shall consist of a perimeter intrusion detection sensor incorporated into a wire security fence. Intrusion detection shall be achieved by sensing the cutting of any single wire or deflection of the fence, such as by climbing.
  - a. Sensor zone: Includes one (1) or more 61 m (200 ft.) maximum sections of 2.3 m (seven (7) ft.) high parallel fence. Each sector shall consist of 13 horizontal barbed wires attached to the taut-wire fence posts, and three (3) strands as outriggers, and an "anti-ladder" trip wire supported by rods extending from the outriggers for a total vertical height of approximately 2.6 m (eight (8) ft.).
  - b. Displacement switches for each horizontal wire shall be mounted 2within a pre-wired channel fastened to the fabric fence post at the midpoint of each section. Outrigger barbed wire and tripwire may share the same switch in these locations.
  - c. Abnormal displacement of a switch lever resulting from cutting or deflecting its attached wire, as by climbing on or through fence strands, shall initiate an alarm condition. A damping mechanism within the sensor shall reduce alarm thresholds due to slowly changing environmental phenomena such as the ground shifting, daily and seasonal temperature variations, winds changes, etc.
  - d. Sensor switches shall be provided with electrical contact closures as a means for initiating an alarm condition.
  - e. The system shall provide relay outputs to interface alarm outputs with the overall IDS.
  - f. Taut-wire Sensor Technical Characteristics:

Power requirements	Input: 120 – 208 VAC
Sensor zone control unit capability	Up to 10 zones
Sensitivity	19 mm (0.75 in.)
Environment Limits	Winds up to 56 km/h (35 mph)

L. Electrostatic Field Sensors

1. These sensors generate an electrostatic field around one (1) or more horizontal wires and detect intrusion of the electrostatic field as follows.
  - a. Sensors shall initiate an alarm when an intruder attempts to approach or scale a fence or physical barrier. Electrostatic field sensors shall detect human presence by generating an electric field around one (1) or more horizontal wires that detects the induced signal in parallel sensing wires.
  - b. Sensors shall monitor the induced signal for changes that result from the presence of a human body, which distorts coupling between transmitting and sensor wires.
  - c. Sensor components shall consist of one (1) or more signal generator field wires and mounting hardware, sensing wires, an amplifier/signal processors, power supplies, and necessary circuitry hardware. Mounting and support hardware shall be provided by the equipment manufacturer.
  - d. Wires shall be spring tension-mounted and provided with end-of-line terminators to detect cutting, shorting, or breaking of the wires.
  - e. Sensor configuration shall be able to detect an intruder that may crawl under the bottom wire, through the wires, or over the top wire by divided sensor zones.
  - f. Signal processing circuitry shall provide filtering to distinguish nuisance alarms.

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- g. Sensor configuration shall incorporate balanced, opposed field construction to eliminate distant field noise.
- h. Sensor sensitivity shall be adjustable. Adjustment controls shall be inaccessible to operating personnel and system sensitivity controls shall be set at approximately midrange.
- i. Sensors shall provide some means of indicating an alarm condition at the protected perimeter to facilitate installation and calibration.
- j. The sensor system shall include an indicator disabling device within a tamperproof enclosure.

2. Electrostatic Field Sensor Technical Characteristics:

Power	115 -120 VAC transformer
Operating Power Requirements	16-22 VAC, 225 mA single zone 275 dual zone
Detection Sensitivity	77 lbs within 915 mm (3 ft.)- midrange setting
Detection Velocity	30 m (0.1 ft.) - 300 m (10 ft.) per sec
Supervision	AC Monitoring of fence and field wires – open, short, and grounded circuits
Tamper Switch	One (1)-pole, two (2) position
Lightening arrestor	Transistors on all relay output and power inputs
Battery Charger	Built-in
Processor Enclosure	Base plate, steel NEMA enclosure Weather resistant

M. Gate Sensors

- 1. They shall be provided in accordance with specific fence sensor manufacturer's recommendations to ensure continuous fence sensor zone protection for the entire protected perimeter.
  - a. When gate units are not provided by the fence sensor manufacturer, provide separately zoned Balanced Magnetic Switch (BMS) gate sensors.
  - b. Sensors shall perform as specified in Section 2.3-E.6 entitled "Balanced Magnetic Switches (BMS)."

**2.10 INTERIOR DETECTION DEVICES (SENSORS)**

- A. The IDS shall consist of interior, exterior, and other detection devices that are capable of:
  - 1. Locating intrusions at individually protected asset areas or at an individual portal;
  - 2. Locating intrusions within a specific area of coverage;
  - 3. Locating failures or tampering of individual sensors or components.
- B. Provide and adjust for devices so that coverage is maximized in the space or area it is installed in. For large rooms where multiple devices are required, ensure device coverage is overlapping.
- C. Detection sensitivity shall be set up to ensure maximum coverage of the secure area is obtained while at the same time limiting excessive false alarms due to the environment and impact of small animals. All detection devices shall be anti-masking with exception of video motion detection.
- D. Dual sensor technology shall be used when possible. Sensor technology shall not be of the same type that is easily defeated by a single method. This will reduce the amount of false alarms.
- E. Interior Environmental Conditions: Systems shall be able to operate in environmentally protected interior areas and shall meet operational performance requirements for the following



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ambient conditions:

1. If components are installed in unheated areas they shall be able to operate in temperatures as low as -17 C (0 F);
2. Interior Sensor Environmental Characteristics:

Temperatures	0 to 50 C (32F to 120 F)
Pressure	Sea Level to 4573m (15,000 ft.) above sea level
Humidity	5% - 95%
Fungus	Components of non-fungus nutrient materials
Acoustical Noise	Suitable for high noise environments above 100db

F. Balanced Magnetic Switches (BMS)

1. BMS switches shall be surface or recessed mounted according to manufacturer's instructions. Recessed mounted is the preferred method to reduce tampering or defeating of the system. Switches shall activate when a disturbance in the balanced magnetic field occurs.
2. Switches shall have a minimum of two (2) encapsulated reed switches.
3. Contractor shall provide each BMS with a current protective device, rated to limit current to 80% of the switch capacity.
4. Surface Mounted BMS: For exterior application, components shall be housed in weatherproof enclosures.
5. BMS field adjustments in the fixed space between magnet and switch housing shall not be possible. Attempts to adjust or disturb the magnetic field shall cause a tamper alarm.
6. BMS Technical Characteristics:

Maximum current	.25 amperes
Maximum voltage	30 VDC
Maximum power	3.0 W (without internal terminating resistors). 1.0 W (with internal terminating resistors).
Components	Three (3) pre-adjusted reed switches Three (3) pre-adjusted magnets
Output contacts	Transfer type SPDT
Contact rating	0.5 amperes, 28 VDC
Switch mechanism	Internally adjustable ¼ - ½ in. (6-13 mm)
Wiring	Two (2) wires #22 American Wire Gauge (AWG), three (3) or 11 foot attached cable
Activation lifetime	1,000,000 activations
Enclosure	Nonferrous materials
Tamper alarm activation	Cover opened 3 mm (1/8 in.) and inaccessible until actuated

G. Window Intrusion Detection

1. These IDS devices shall detect intrusions thru inertia (shock) or by sound, and shall utilize either a Breakwire Sensor or Acoustic and Seismic Sensor.
2. Break wire Sensors (wire trap):

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- a. Detect intrusion thru shock or breakage of window glazing. Also used for the protection of utility openings.
- b. Sensors shall consist of fine wire embedded in or affixed to interior of glazing. Breakage of protected glazing shall result in wire breakage.
- c. Wire shall be hard-drawn copper up to #26 AWG diameter.
- d. If sensors are affixed to glazing the sensor shall be protected by a clear coating which shall not affect sensor functioning.
- e. Sensor shall be terminated in insulated connectors which are concealed and tamper resistant.
- f. Protection of inlet openings:
  - 1) Shall consist of up to 26 AWG hard-drawn copper wire with a tensile strength of 17.8 N 4 pounds maximum.
  - 2) Wire shall be interlaced throughout the opening such that no opening between wires shall be larger than 100 mm (4 in.. on center.
  - 3) Sensors shall be terminated so that attempts to cut the wire or otherwise enlarge openings between wires shall cause an alarm.
  - 4) Sensors shall be terminated in insulated connectors which are concealed and tamper resistant.

H. Acoustic and Seismic Glass Break Detectors

- 1. Detects intrusion thru the use of audible sound and vibration emitted from the breaking of glass using a tuned frequency range and sound pattern recognition. This initiates an alarm when glass they protect is broken or cracked.
- 2. Detectors shall be installed in strict conformance with manufacture’s installation instructions.
- 3. The detector’s power circuit shall be switched via an output relay on the control panel to provide latching alarm LED reset capability.
- 4. Sensors shall be contained in a fire-resistant ABS plastic housing and must be mounted in contact with a window.
- 5. Sensing shall be accomplished through the use of a mechanical filtered piezoelectric element.
- 6. Sensors shall have a sensitivity adjustment controlling output voltage from the piezoelectric element which triggers a solid-state latching device.
- 7. Sensors shall selectively filter input to minimize false alarms and not initiate alarm in response to ambient seismic vibrations or other ambient stimuli.
- 8. A manufacture’s test unit will be used to validate the sensor by simulating glass breakage.
- 9. The Contractor shall provide sensors for adjusting sensitivity and two-sided polyurethane tape with acrylic adhesive for window attachment.
  - 1) Sensor shall include exterior label to protect adhesive tape from direct sunlight.
  - 2) Window Intrusion Detection Sensor Technical Specifications:

Power	Auxiliary power supply 12 VDC @ 25 mA (+/-) 10%
Power Input	10 – 15 VDC at 16mA protected against reverse polarity, 20 mA during relay closure
Relay Output Rating	Minimum of 25 VDC mA
Coverage Audio	6,000 Square ft.
Coverage Glass Break	7.5 m (25 ft.) wide by 7.5 m wide (25 ft.) Minimum: 7.62 m (25 feet) from the detector to the furthest point on protected

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	glass.
Audio Output	300 – 12,000 HZ
Alarm Output	Relay NO or NC selectable
Interconnection	12 pin Panduit connector, 22 AWG
Radio Frequency Interface	No alarm or setup on between frequencies 26 – 100 MHz 50 v/m  Immunity to mobile RF interference 100 watts 3 m @ (9.8 Ft.) in 27-100 MHz range
Alarm period	Two (2) to three (3)
Mounting	Ceiling, same wall, adjacent wall, opposite wall
Features	Test and alarm LEDs for acoustic seismic and alarm condition latching, Alarm LED and tamper switch on cover.
Alarm verification	Digital signal processing or dual acoustic processing technologies
Detection ability	Single and multi-pane glass, wired glass, tempered and laminated glass to 6 mm (¼ inch) or thickness

I. Screening

1. This material shall be used on windows to protect and detect intrusion as follows.
  - a. Security screens shall be constructed from a maximum of 26 AWG insulated hard-drawn copper.
  - b. Screens shall be connected to an alarm circuitry by means of flexible armored cords. Security screen circuitry shall provide end-of-line resistors in series or equivalent methods ensuring alarm activation if short-circuiting of the screen is attempted.
  - c. If unable to install a break wire sensor (wire traps), then tamper switches will be provided.
  - d. Contractor shall provide tamper switches in the frames as required with not less than one (1) switch on each side if dimensions are 610 mm two ((2) ft. square) or less, and two (2) switches if dimensions exceed 610 mm (2 ft. square). Tamper switches shall be corrosion-resistant, spring-operated, and shall initiate an alarm with a movement of 50 mm (two (2) in.) or less before access to the switch is possible.
  - e. Electrical characteristics of the switch shall match the alarm system requirements.

J. Vibration Sensors

1. These sensors shall initiate alarms upon detecting drilling, cutting, or blasting through walls, or other methods of forced entry through a structure as follows.
2. Sensors shall detect and selectively amplify signals generated by forced penetration of a protective structure.
3. Sensors shall be designed to give peak response to structurally conveyed vibrations associated with forcible attack on the protected surface.
4. Sensors will initiate an alarm if attempts are made to remove them from the surface of the wall.
5. Sensors shall be enclosed in protective mountings.
6. Sensors shall include an adjustable alarm discriminator to prevent incidental vibrations which may occur from triggering the alarm circuit.
7. Sensors shall be provided with a tamper switch.

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8. Sensor sensitivity shall be individually adjustable unless a sensor is designed to accommodate vibration ranges of specific surface type on which it will be mounted. Sensitivity adjustments shall not be accessible without removing the sensor cover. Also, a sensor shall not be responsive to airborne sound.

9. Vibration Sensor Technical Characteristics:

Power requirements	External DC power source Eight (8)- 14.5 VDC, two (2) volt max peak to peak ripple
Alarm output	Form C (NO/C/NC) solid state alarm relay, rated 100 mA, 28 VDC
Tamper Connection	Tamper switch and external magnetic
Current rating and alarm output	No alarm state 20mA SPDT relay contact rating (Form C)
Sensor range	Concrete (poured) 4 m (13.2 ft.) Concrete block 2 m (6.6 ft.) Brick block 1 m (3.3 ft.)
Frequency range	3kHz-20kHz (-15db) 7kHz-10kHz (-10db)
Adjustable	Sensitivity eight (8) steps Alarm response 0-30 sec

- K. Passive Infrared Motion Sensors (PIR)

1. These sensors shall detect an intruder presence by monitoring the level of infrared energy emitted by objects within a protected zone and meet ANSI PIR-01 Passive Infrared Motion Detector Standards Features for Enhancing False Alarm Immunity. An alarm shall be initiated when motion and temperature changes within set patterns are detected as follows.
2. The detector shall provide multiple detection zones distributed at a variety of angles and distance.
3. Sensors shall be passive in nature; no transmitted energy shall be required for detection.
4. Sensors shall be sensitive to infrared energy emitted at wavelengths corresponding to human body and other objects at ambient temperatures.
5. Sensors shall not alarm in response to general area thermal variations and shall be immune to radio frequency interference.
6. Sensors shall not be susceptible to changes in temperature due to an air conditioner being turned on or off.
7. Sensors shall be housed in a tamper-alarmed enclosure.
8. Sensor detectors shall include motion analyzer processing, adjustable lens, and walk test LED's visible from any angle.
9. Sensors shall provide some means of indicating an alarm condition during installation and calibration. A means of disabling the indication shall be provided within the sensor enclosure.
10. Sensor detectors shall include a motion monitoring verification circuit that will signal trouble or alarm if the detector fails to detect motion for an extended period.
11. PIR Technical Characteristics:

Power	Six (6) – 12 VDC 25 mA continuous current draw 38 mA peaks
Alarm Velocity	1500 mm (Five (5) ft.) at a velocity of 30 mm (0.1 ft.) per second, and one (1) step per second, assuming 150 mm (6 in.) per step.

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	Also, faster than 30 mm (1 foot) per second, up to 3000 mm (10 feet) per second
Maximum detection range	10.6 m (35 ft.)
Frequency range- non activation or setup use	26 to 950 MHz using a 50 watt transmitter located 1 ft. from the unit or attached wiring
Infrared detection	1 1/2°C (3°F) different from the background temperature
Detection Pattern	180 degrees for volumetric units, non PIR 360
PIR 360°Detection Pattern	Programmable 60 detection zones including one directly below
Mounting	Ceiling and walls
Ceiling heights	2.4 m (Eight (8) ft.) – 5.4 m (18 ft)
Sensitivity adjustments	Three (3) levels

L. Microwave-Passive Infrared Detector

1. This sensor shall be designed to detect the motion of a human body within a protected area by means of a combination of microwave sensing technology and passive infrared (MPIR) sensing technology as follows.
2. The sensor shall require both technologies to sense intrusion before an alarm may occur.
3. The sensor shall be designed for wall mounting on swivel bracket. A high-security gimbaled bracket shall be provided.
4. The PIR fields of view shall be focused on the pyroelectric element by means of an internal multi-faceted mirror.
5. The sensor shall incorporate a look-down lens system that detects the passing of an intruder directly beneath the sensor.
6. The sensor shall incorporate a microwave supervision system which shall activate the trouble output if the device technology fails.
7. The sensor shall incorporate self-diagnostics which shall monitor the sensor systems and report a trouble to the control panel if any system device fails.
8. The sensor shall have compensation against loss of sensitivity as the ambient temperature nears human body temperature.
9. MPIR Technical Characteristics:

Technology	Microwave and Passive Infrared
Power	Nine (9) – 15 VDC max current consumption 22 mA at 12 VDC
Operating Temperature	0° C (32°F) – 49° C (120° F)
Detection Area	30 m (98 ft.) long by 3 m (9.8 ft.) wide or 21 m (69 ft.) long by 21m (69 ft.) wide
Electronics	Microcontroller based
Alarm Contact	Form-C rated 125 mA, 28 VDC
Tamper Contact	125 mA, 28 VDC
Trouble Contact	Form-B rated 25 mA, 30 VDC
Microwave Operating Frequency	10.525 GHz
Microwave Sensitivity	Adjustable on circuit board
Detection pattern adjustment	Changing of internal lens
Sensing element	Pyro-electric
LED Indicators	PIR, microwave, alarm
Bug and Dust protection	zero-clearance, gasket bug guard

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Lens	Interchangeable: standard 18x24 m (60x80 ft.), corner mounting, ultra-wide, pet alley, long range, room and corridor combo, room and ceiling combo, creep zone
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M. Photoelectric Sensors

1. The sensor devices shall be able to detect an intruder presence by sending out a series of infrared or ultraviolet beams. Intrusion is based on disruption of the signal beams as follows.
  - a. Sensors shall consist of a modulating transmitter, focusing lenses, mirrors, demodulating receiver, power supply, and interconnecting lines.
  - b. Beam transmitters shall be designed to emit light. Beams may be reflected by one (1) or more mirrors before being received and amplified.
  - c. The photoelectric sensor shall initiate an alarm when the beam is interrupted with monitoring controls set at midrange.
  - d. Transmitted beams shall be uniquely modulated to prohibit defeat of the IDS system by shining another light source into the receiver.
  - e. Sensors shall provide a means of local alarm indication on the detector for use at the protected zone during installation and calibration.
  - f. Sensors shall include an indicator-disabling device within the sensor enclosure.
  - g. Sensors shall utilize automatic gain control or be provided with sensitivity adjustments to allow for various beam lengths.
  - h. Sensor controls shall be inaccessible to operating personnel.
  - i. Sensors that use multiple beams shall be tested by attempting to crawl under and jump through and over beams. Each system sensor shall provide cutoffs of at least 90% to handle a high percentage of light cutoffs prior to initiating an alarm.
  - j. Sensor components shall be housed in tamper-alarmed enclosure.
2. Photoelectric Sensor Technical Characteristics:

Power requirements	Nine (9)-16 VDC, protected against reverse polarity
Relay output	Normally closed. 18 ohm resistor in series with contacts. 0.5 amperes resistance/24 VDC
Current	Transmitter 15 mA, Receiver 15 mA
LED	Alignment, walk-test alarm, off
Range	Indoor: 39 m (130 ft.) Outdoor: 19.5 m: (65 ft.)
Alarm relay contacts	Two (2) amperes at 120 VAC minimum
Enclosure	High impact acrylic
Type	Dual beam
Mounting	Wall, corner, flush
Beam width	Six (6) degrees
Receiver field of view	Six (6) degrees horizontal and vertical
Adjustments	Vertical +10 – 20 degrees Horizontal 30 degrees
Alarm period	Two (2) – three (3) sec
Infrared source	Long-life Gallium Arsenide LED
Infrared sensor	PIN photodiode
Transmitter Frequency	One (1) kHz 10 microsecond pulse width
IR Wavelength	950 nm

- N. CCTV Video Motion Detection Sensors: Refer to Section 28 23 00 VIDEO SURVEILLANCE that outlines related video motion detection requirements.

**2.11 TAMPER ALARM SWITCHES**

- A. The following IDS sensors shall be used to monitor and detect potential tampering of sensors, control panels and enclosures.
1. Tamper Switches: All enclosures including cabinets, housings, boxes, raceways, and fittings with hinged doors or removable covers containing circuits and power supplies related to the IDS shall include corrosion-resistant tamper switches.
  2. Tamper alarms shall be annunciated to be clearly distinguishable from IDS alarms.
  3. Tamper switches will not be in a viewable from a direct line of sight perspective. The minimum amount of time the tamper switch becomes active and sends a signal after an enclosure is opened or panel removable is attempted, shall be one (1) second.
  4. Tamper switches will initiate when enclosure doors or covers is removed as little as 6.35 mm (1/4 inch) from the closed position unless otherwise indicated. Tamper switches shall be:
    - a. Push/pull automatic reset type;
    - b. Inaccessible until switch is activated;
    - c. Spring-loaded and held in closed position by door or cover; and
    - d. Wired to break a circuit when door or cover is removed with each sensor annunciated individually at a central reporting processor.
  5. Fail-Safe Mode: Shall provide the capability to detect and annunciate diminished functional capabilities and perform self-tests. Fail-safe alarms shall be annunciated to be clearly distinguishable from other types of alarms.

**2.12 POWER SUPPLY**

- A. A power supply shall only be utilized if the control panel is unable to support the load requirements of the IDS system.
- B. All power supplies shall be UL rated and able to adequately power two entry control devices on a continuous base without failure.
- C. Power supplies shall meet the following minimum technical characteristics:

INPUT POWER	110 VAC 60 HZ 2 amp
OUTPUT VOLTAGE	12 VDC Nominal (13.8 VDC) 24 VDC Nominal (27.6 VDC) Filtered and Regulated
BATTERY	Dependant on Output Voltage shall provide up to [insert number ]Ah, rechargeable
OUTPUT CURRENT	4 amp max. @ 13.8 VDC 3 amp max. @ 27.6 VDC
BATTERY FUSE SIZE	3.5 A @ 250 VAC
CHARGING CIRCUIT	Built-in standard

**2.13 AUDIBLE AND VISUAL ALARM DEVICES**

- A. Bell: Central-station control unit 10 inches (254 mm) in diameter, rated to produce a minimum sound output of 84 dB at 10 feet (3 m) from central-station control unit.
1. Enclosure: Weather-resistant steel box equipped with tamper switches on cover and on back of box.
- B. Weatherproof Motor-Driven Hooter: UL listed, rated to produce a minimum sound output of 120 dB at 3 feet (1 m), plus or minus 3 dB, at a frequency of 470 Hz. Rated for intermittent use: two minutes on and five minutes off.

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1. Designed for use in industrial areas and in high noise, severe weather marine environments.
- C. Siren: 30-W speaker with siren driver, rated to produce a minimum sound output of 103 dB at 10 feet (3 m) from central-station control unit.
  1. Enclosure: Weather-resistant steel box with tamper switches on cover and on back of box.
- D. Strobe: Xenon light complying with UL 1638, with a clear polycarbonate lens.
  1. Light Output: 115 cd, minimum.
  2. Flash Rate: 60 per minute.

#### **2.14 SECURITY FASTENERS**

- A. Security fasteners shall be operable only by tools produced for use on specific type of fastener by fastener manufacturer or other licensed fabricator. Drive system type, head style, material, and protective coating as required for assembly, installation, and strength.
- B. Drive System Types: Pinned Torx or pinned hex (Allen).
- C. Socket Flat Countersunk Head Fasteners:
  1. Heat-treated alloy steel, ASTM F 835 (ASTM F 835M).
  2. Stainless steel, ASTM F 879 (ASTM F 879M), Group 1 CW.
- D. Socket Button Head Fasteners:
  1. Heat-treated alloy steel, ASTM F 835 (ASTM F 835M).
  2. Stainless steel, ASTM F 879 (ASTM F 879M), Group 1 CW.
- E. Socket Head Cap Fasteners:
  1. Heat-treated alloy steel, ASTM A 574 (ASTM A 574M).
  2. Stainless steel, ASTM F 837 (ASTM F 837M), Group 1 CW.
- F. Protective Coatings for Heat-Treated Alloy Steel:
  1. Zinc chromate, ASTM F 1135, Grade 3 or 4; for exterior applications and interior applications where indicated.
  2. Zinc phosphate with oil, ASTM F 1137, Grade I, or black oxide.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION**

- A. IDS installation shall be in accordance with Underwriters Laboratories (UL) 639 Standards for Intrusion Detection Units and UL 634 Standards for Connectors with Burglar Alarm Systems, and appropriate manufacture's installation manuals for each type of IDS.
- B. Components shall be configured with appropriate "service points" to pinpoint system trouble in less than 30 minutes.
- C. The Contractor shall install all system components including VA furnished equipment, and appurtenances in accordance with the manufacturer's instructions and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable system.
- D. The IDS will be designed, engineered, installed, and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the system is a stand alone or designed as a computer network.
- E. The IDS shall be able to be integrated with other security subsystems. Integration with these security subsystems shall be achieved by computer programming and the direct hardwiring of the systems. Determination for methodology shall be outlined when the system(s) is/are being designed and engineered. For installation purposes, the IDS shall utilize an output module for integration with other security subsystems. The Contractor will ensure all connections are per the OEM and that any and all software upgrades required to integrate the systems are installed prior to system start-up.



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- F. For programming purposes, the Contractor shall refer to the manufacturer's requirements and Contracting Officer instructions for correct system operations. This includes ensuring computers being utilized for system integration meet or exceeds the minimum system requirements outlined in the IDS software packages.
- G. Lightening and power surges to the central alarm reporting and display unit shall be protected at both ends against excessive voltages. This requirement shall apply for circuits that are routed both in underground conduits and overhead runs.
- H. At a minimum, the Contractor shall install primary detection devices, such as three electrode gas-type surge arresters, and secondary protectors to reduce dangerous voltages to levels that will cause no damage. Fuses shall not be permitted as protection devices.
- I. The Contractor shall provide fail-safe gas tube type surge arresters on exposed IDS data circuits. In addition, transient protection shall protect against spikes up to 1000 volts peak voltage with a one-microsecond rise time and 100-microsecond decay time, without causing false alarms. The protective device shall be automatic and self-restoring. Also, circuits shall be designed or selected assuming a maximum of 25 ohms to ground.
- J. Product Delivery, Storage and Handling:
  - 1. Delivery: Deliver materials to the job site in OEM's original unopened containers, clearly labeled with the OEM's name, equipment model and serial identification numbers, and UL logo. The Contracting Officer may inventory the IDS equipment at the time of delivery and reject items that do not conform to this requirement.
  - 2. Storage and Handling: Store and protect equipment in a manner that will preclude damage as directed by the Contracting Officer.
- K. Cleaning and Adjustments:
  - 1. Cleaning: Subsequent to installation, clean each system component of dust, dirt, grease, or oil incurred during installation in accordance to manufacture instructions.
  - 2. Prepare for system activation by following manufacturer's recommended procedures for adjustment, alignment, or synchronization. Prepare each component in accordance with appropriate provisions of the component's installation, operations, and maintenance instructions.
- L. Tamper Switches
  - 1. Install tamper switches to initiate an alarm signal when a panel, box, or component housing door or cover is moved as little as 6.35 mm (1/4 inch) from the normally closed position unless otherwise specified.
  - 2. Locate tamper switches within enclosures, cabinets, housings, boxes, raceways, and fittings to prevent direct line of sight to any internal components and to prevent tampering with switch or circuitry.
  - 3. Conceal tamper switch mounting hardware so that the location of the switch within the enclosure cannot be determined from the exterior.
- M. Unique IDS Installation Components:
  - 1. BMS Surface Mounted:
    - a. Surface mounted BMS housing for the switch element shall have the capability to receive threaded conduit. Housing covers for surface mounted BMS, if made of cast aluminum, shall be secured by stainless steel screws. Magnet housing cover shall not be readily removable and BMS housings shall be protected from unauthorized access by a cover operated, corrosion-resistant tamper device.
    - b. Conductors running from a door to alarm circuits shall be contained within a flexible armored cord constructed from corrosion-resistant metal. Each end of the armored cord shall terminate in a junction box or other enclosure. Armored cord ends shall be mechanically secured to the junction boxes by clamps or bushings. Conductors within the armored cord shall be provided with lug terminals at each end. Conductors and the armored cord shall experience no mechanical strain as the door is removed from

- fully open to closed position. Switch circuits shall initiate an alarm if a short circuit is applied to the door cord.
- c. For exterior application on double gates, both BMS elements must be mounted on the gate. Flexible armored cord constructed from corrosion-resistant metal shall be used to provide electrical connection.
2. BMS Recessed Mounted:
    - a. Ball bearing door trips shall be mounted within vault door headers such that when the locking mechanism is secured, the door bolt engages an actuator, mechanically closing the switch.
    - b. Door bolt locking mechanisms shall be fully engaged before the ball bearing door trip is activated. Also, circuit jumpers from the door shall be provided.
  3. Vibration Sensors:
    - a. Mount vibration sensors directly contacting the surface to be protected.
    - b. Provide at least one (1) sensor on each monolithic slab or wall section, even though spacing closer than that required for midrange sensitivity may result.
    - c. House sensors in protective mountings and fasten to surface with concealed mounting screws or an epoxy.
    - d. Adjust discriminator on the job to precise needs of application. Connect sensors to an electronic control unit by means of wiring or fiber optics cable run in rigid steel conduit or electrical metallic tubing (EMT).
  4. Passive Infrared Detectors: (PIR)
    - a. The protective beam shall be focused in a straight line.
    - b. Installed beam distance from transmitter to receiver shall not exceed 80% of the manufacturer's maximum recommended rating.
    - c. Mirrors may be used to extend the beam or to establish a network of beams. Each mirror used shall not lower the rated maximum system range by more than 50%.
    - d. Mirrors and photoelectric sources used in outdoor applications shall have self-heating capability to eliminate condensation and shall be housed in weatherproof enclosures.
  5. Taut-Wire:
    - a. Housing for switch assembly shall be covered by a neoprene cap to retain the center bolt (lever arm), which functions as a lever to translate movement of the attached horizontal wire into contact closure. When the neoprene cap is firmly seated on the cup-shaped polycarbonate housing, it shall function as the fulcrum for the lever (bolt).
    - b. Upper exposed end of the lever shall be threaded to accommodate clamping to the horizontal wire. The lower end of the lever, which is fashioned to serve as the movable electrical contact, shall be held suspended in a small cup-shaped contact that floats in a plastic putty material.
    - c. Plastic putty used shall retain a degree of elasticity under varying temperature conditions and provide the sensor switch with a self-adjusting property. This provides the switch with a built-in compensating mechanism that ignores small, very slow changes in lever alignment (i.e. which may result from environmental changes such as extreme temperature variations and ground seepage due to weather conditions) and to react to fast changes only, as caused by manual deflection or cutting of the wires.
    - d. Contractor shall provide metal slider strips having slots through which the barbed wires pass. Wires shall be prevented from leaving the slots by rivets. A slider strip shall be used to translate normal forces to the barbed wire and to the horizontal displacement of the sensor.
    - e. Install one (1) slider strip pair, upper and lower, on every fence post except where sensor posts or anchor strips are installed.
    - f. Separation between slider elements along the fence shall be 3000 mm (10 feet).
    - g. Attach wires of sensor to existing, specially installed fence posts, called anchor posts, located equidistant on both sides of sensor posts and at ends of sensor zone run.

- h. Anchor strip shall be a strip of steel plate on which fastening plates are installed. Weld or otherwise attach the strip to anchor post and ends of tensed barbed wires wrapped around the fastening plates. Attempts to climb on fastening plates or on the attached barbed wires shall cause plates to break off, creating an alarm and making it impossible to defeat the system by climbing at the anchor post.
  - i. The use of barbed wire as part of the IDS system shall be suitable for installation under a preload tension of approximately 392 N 88 pounds and be flexible enough for convenient manipulation during tensioning. Double-strand 15 1/2-gage barbed wire shall be the minimum acceptable.
6. Electromechanical Fence Sensors:
- a. The fence length shall be divided into 100m (300 ft). or zones.
  - b. Sensors shall consist of individual electromechanical sensing units mounted every three-thousand and 3045mm (10 ft). on the fence fabric or posts and wired in series to a sensor zone control unit and associated power supply.
7. Electrostatic Field Sensors:
- a. Sensors shall be capable of following irregular contours and barrier bends without degrading sensitivity below the specified detection level.
  - b. In no case shall a single sensor zone exceed 100m (300 ft). or be long enough to significantly degrade sensitivity.
  - c. Adjacent zones shall provide continuous coverage to avoid a dead zone. Adjacent zones shall be designed to prevent crosstalk interference.
  - d. Exterior components shall be housed in rugged corrosion-resistant enclosures, protected from environmental degradation and include tamper switches.
  - e. Interfacing between exterior units shall be carried in underground cables.
  - f. Exterior support hardware shall be stainless or galvanized to avoid tension degradation.
  - g. Sensor and field wires shall be stainless steel. Wire spacing for various configurations shall be maintained constant throughout each zone and shall be uniform with respect to the ground and follow manufacturer's specifications.
  - h. Signal processing equipment shall be separately mounted such that no desensitized zones are created within the zone of detection.
8. Microwave: Do not install microwave sensors where fluorescent lights may pose a problem due to radiated ionization from lights.

### 3.02 WIRING INSTALLATION

- A. Wiring Method: Install wiring in metal raceways according to Section 28 05 28.33 "CONDUITS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY." Conceal raceway except in unfinished spaces and as indicated. Minimum conduit size shall be 3/4 inch (20 mm). Control and data transmission wiring shall not share conduit with other building wiring systems.
- B. Wiring Method: Install wiring in raceways except in accessible indoor ceiling spaces and in interior hollow gypsum board partitions where cable may be used. Conceal raceways and wiring except in unfinished spaces and as indicated. Minimum conduit size shall be 3/4 inch (20 mm). Control and data transmission wiring shall not share conduit with other building wiring systems.
- C. Wiring Method: Cable, concealed in accessible ceilings, walls, and floors when possible.
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- E. Wires and Cables:

1. Conductors: Size as recommended in writing by system manufacturer, unless otherwise indicated.
  2. 120-V Power Wiring: Install according to Division 26 Section "LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES," unless otherwise indicated.
  3. Control and Signal Transmission Conductors: Install unshielded, twisted-pair cable, unless otherwise indicated or if manufacturer recommends shielded cable, according to Division 28 Section "CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY."
  4. Computer and Data-Processing Cables: Install according to Division 28 Section "CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY."
  5. Television Signal Transmission Cables: Install according to Division 28 Section "CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY."
- F. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- G. Install power supplies and other auxiliary components for detection devices at controllers, unless otherwise indicated or required by manufacturer. Do not install such items near devices they serve.
- H. Identify components with engraved, laminated-plastic or metal nameplate for central-station control unit and each terminal cabinet, mounted with corrosion-resistant screws.

### **3.03 GROUNDING**

- A. Ground system components and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- B. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding. Provide [5] -ohm ground. Measure, record, and report ground resistance.
- C. Install grounding electrodes of type, size, location, and quantity indicated. Comply with installation requirements in Division 28 Section "GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY SYSTEMS."

### **3.04 STARTUP AND TESTING**

- A. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior notice.

### **3.05 COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of Section 28 08 00 – COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 28 08 00 – COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS and related sections for contractor responsibilities for system commissioning.

### **3.06 TESTS AND TRAINING**

- A. All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.
- B. Provide services of manufacturer's technical representative for [insert number] hours to instruct VA personnel in operation and maintenance of units.

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- C. Submit training plans and instructor qualifications in accordance with the requirements of Section 28 08 00 – COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

**END OF SECTION**

**SECTION 282300  
VIDEO SURVEILLANCE**

**PART 1 – GENERAL**

**1.01 DESCRIPTION**

- A. Provide and install a complete Video Surveillance System, which is identified as the Video Assessment and Surveillance System hereinafter referred to as the VASS System as specified in this section.
- B. This Section includes video surveillance system consisting of cameras, data transmission wiring, and a control station with its associated equipment.
- C. Video surveillance system Video assessment & surveillance system shall be integrated with monitoring and control system specified in Division 28 Section that specifies systems integration.

**1.02 RELATED WORK**

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- B. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping application and use.
- C. Section 10 14 00 - SIGNAGE. Requirements for labeling and signs.
- D. Section 26 05 41 - UNDERGROUND ELECTRICAL CONSTRUCTION. Requirements for underground installation of wiring.
- E. Section 28 05 00 – COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. Requirements for general requirements that are common to more than one section in Division 28.
- F. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.
- G. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.
- H. Section 28 05 28.33 - CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.
- I. Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY. Requirements for commissioning, systems readiness checklists, and training.
- J. Section 28 13 00 - PHYSICAL ACCESS CONTROL SYSTEM. Requirements for physical access control system integration.
- K. Section 28 13 16 - PHYSICAL ACCESS CONTROL SYSTEM AND DATABASE MANAGEMENT. Requirements for control and operation of all security systems.
- L. Section 28 16 00 - INTRUSION DETECTION SYSTEM (IDS). Requirements for alarm systems.
- M. Section 28 26 00 - ELECTRONIC PERSONAL PROTECTION SYSTEM (EPPS). Requirements for emergency and interior communications.

**1.03 DEFINITIONS**

- A. AGC: Automatic gain control.
- B. B/W: Black and white.
- C. CCD: Charge-coupled device.
- D. CIF: Common Intermediate Format CIF images are 352 pixels wide and 88/240 (PAL/NTSC) pixels tall (352 x 288/240).
- E. 4CIF: resolution is 704 pixels wide and 576/480 (PAL/NTSC) pixels tall (704 x 576/480).
- F. H.264 (also known as MPEG4 Part 10): a encoding format that compresses video much more effectively than older (MPEG4) standards.

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- G. ips: Images per second.
- H. MPEG: Moving picture experts group.
- I. MPEG4: a video encoding and compression standard that uses inter-frame encoding to significantly reduce the size of the video stream being transmitted.
- J. NTSC: National Television System Committee.
- K. UPS: Uninterruptible power supply.
- L. PTZ: refers to a movable camera that has the ability to pan left and right, tilt up and down, and zoom or magnify a scene.

**1.04 QUALITY ASSURANCE**

- A. The Contractor shall be responsible for providing, installing, and the operation of the VASS System as shown. The Contractor shall also provide certification as required.
- B. The security system shall be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the security system is stand-alone or a part of a complete Information Technology (IT) computer network.
- C. The Contractor or security sub-contractor shall be a licensed security Contractor as required within the state or jurisdiction of where the installation work is being conducted.
- D. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.
- E. Product Qualification:
  - 1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
  - 2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.
- F. Contractor Qualification:
  - 1. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years experience installing and servicing systems of similar scope and complexity. The Contractor shall be an authorized regional representative of the Video Assessment and Surveillance System's (VASS) manufacturer. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity which became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system. The references must include a current point of contact, company or agency name, address, telephone number, complete system description, date of completion, and approximate cost of the project. The owner reserves the option to visit the reference sites, with the site owner's permission and representative, to verify the quality of installation and the references' level of satisfaction with the system. The Contractor shall provide copies of system manufacturer certification for all technicians. The Contractor shall only utilize factory-trained technicians to install, program, and service the VASS. The Contractor shall only utilize factory-trained technicians to install, terminate and service cameras, control, and recording equipment. The technicians shall have a minimum of five (5) continuous years of technical experience in electronic security systems. The Contractor shall have a local service facility. The facility shall be located within 60 miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with this contract. The facility shall also include appropriate diagnostic equipment to perform diagnostic procedures. The COTR reserves the option of surveying the company's facility to verify the service inventory and presence of a local service organization.

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2. The Contractor shall provide proof project superintendent with BICSI Certified Commercial Installer Level 1, Level 2, or Technician to provide oversight of the project.
  3. Cable installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International. The staff member shall provide consistent oversight of the project cabling throughout design, layout, installation, termination and testing.
- G. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within eight hours of receipt of notification that service is needed. Submit name and address of service organizations.

**1.05 SUBMITTALS**

- A. Submit below items in conjunction with Master Specification Sections 01 33 23, Shop Drawings, Product Data, and Samples, and Section 02 41 00, Demolition Drawings.
- B. Provide certificates of compliance with Section 1.4, Quality Assurance.
- C. Provide a pre-installation and as-built design package in both electronic format and on paper, minimum size 1220 x 1220 millimeters (48 x 48 inches); drawing submittals shall be per the established project schedule.
- D. Pre-installation design and as-built packages shall include, but not be limited to:
  1. Index Sheet that shall:
    - a. Define each page of the design package to include facility name, building name, floor, and sheet number.
    - b. Provide a list of all security abbreviations and symbols.
    - c. Reference all general notes that are utilized within the design package.
    - d. Specification and scope of work pages for all security systems that are applicable to the design package that will:
      - 1) Outline all general and job specific work required within the design package.
      - 2) Provide a device identification table outlining device Identification (ID) and use for all security systems equipment utilized in the design package.
  2. Floor plans, site plans, and enlarged plans shall:
    - a. Include a title block as defined above.
    - b. Define the drawings scale in both standard and metric measurements.
    - c. Provide device identification and location.
    - d. Address all signal and power conduit runs and sizes that are associated with the design of the electronic security system and other security elements (e.g., barriers, etc.).
    - e. Identify all pull box and conduit locations, sizes, and fill capacities.
    - f. Address all general and drawing specific notes for a particular drawing sheet.
  3. A riser drawing for each applicable security subsystem shall:
    - a. Indicate the sequence of operation.
    - b. Relationship of integrated components on one diagram.
    - c. Include the number, size, identification, and maximum lengths of interconnecting wires.
    - d. Wire/cable types shall be defined by a wire and cable schedule. The schedule shall utilize a lettering system that will correspond to the wire/cable it represents (example: A = 18 AWG/1 Pair Twisted, Unshielded). This schedule shall also provide the manufacturer's name and part number for the wire/cable being installed.
  4. A system drawing for each applicable security system shall:
    - a. Identify how all equipment within the system, from main panel to device, shall be laid out and connected.
    - b. Provide full detail of all system components wiring from point-to-point.



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- c. Identify wire types utilized for connection, interconnection with associate security subsystems.
- d. Show device locations that correspond to the floor plans.
- e. All general and drawing specific notes shall be included with the system drawings.
5. A schedule for all of the applicable security subsystems shall be included. All schedules shall provide the following information:
  - a. Device ID.
  - b. Device Location (e.g. site, building, floor, room number, location, and description).
  - c. Mounting type (e.g. flush, wall, surface, etc.).
  - d. Power supply or circuit breaker and power panel number.
  - e. In addition, for the VASS Systems, provide the camera ID, camera type (e.g. fixed or pan/tilt/zoom (P/T/Z), lens type (e.g. for fixed cameras only) and housing model number.
6. Detail and elevation drawings for all devices that define how they were installed and mounted.
- E. Pre-installation design packages shall be reviewed by the Contractor along with a VA representative to ensure all work has been clearly defined and completed. All reviews shall be conducted in accordance with the project schedule. There shall be four (4) stages to the review process:
  1. 35 percent
  2. 65 percent
  3. 90 percent
  4. 100 percent
- F. Provide manufacturer security system product cut-sheets. Submit for approval at least 30 days prior to commencement of formal testing, a Security System Operational Test Plan. Include procedures for operational testing of each component and security subsystem, to include performance of an integrated system test.
- G. Submit manufacture's certification of Underwriters Laboratories, Inc. (UL) listing as specified. Provide all maintenance and operating manuals per the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.
- H. Submit completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

#### **1.06 APPLICABLE PUBLICATIONS**

- A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA):
  1. 330-09 - Electrical Performance Standards for CCTV Cameras
  2. 375A-76 - Electrical Performance Standards for CCTV Monitors
- C. Institute of Electrical and Electronics Engineers (IEEE):
  1. C62.41-01 - IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits
  2. 802.41-02 - Power over Ethernet Standard
- D. Federal Communications Commission (FCC):
  1. (47 CFR 15) Part 15 - Limitations on the Use of Wireless Equipment/Systems
- E. National Electrical Contractors Association (NECA):
  1. 303-2005 - Installing Closed Circuit Television (CCTV) Systems

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- F. National Fire Protection Association (NFPA):
  - 1. 70-08 - Article 780-National Electrical Code
- G. Federal Information Processing Standard (FIPS):
  - 1. 140-2-02 - Security Requirements for Cryptographic Modules
- H. Underwriters Laboratories, Inc. (UL):
  - 1. 983-06 - Standard for Surveillance Camera Units
  - 2. 3044-01 - Standard for Surveillance Closed Circuit Television Equipment

### 1.07 COORDINATION

- A. Coordinate arrangement, mounting, and support of video surveillance equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for video surveillance items that are behind finished surfaces or otherwise concealed.

### 1.08 WARRANTY OF CONSTRUCTION

- A. Warrant VASS System work subject to the Article "Warranty of Construction" of FAR clause 52.246-21.
- B. Demonstration and training shall be performed prior to system acceptance.

## PART 2 – PRODUCTS

### 2.01 GENERAL

- A. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.
- B. Power Connections: Comply with requirements in Section 28 05 00 COMMON WORK REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY, Part 2, as recommended by manufacturer for type of line being protected.
- C. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station, control-unit alarm display shall identify tamper alarms and indicate locations.

### 2.02 CAMERAS

- A. All Cameras will be EIA 330 and UL 1. Minimum Protection for Power Connections 120 V and more: Auxiliary panel suppressors shall comply with requirements in Section 28 05 00 COMMON WORK REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY, Part 2.
- B. Minimum Protection for Communication, Signal, Control, and Low-Voltage 983 compliant as well as:
  - 1. Will be charge coupled device (CCD cameras and shall conform to National Television System Committee (NTSC) formatting.
  - 2. Fixed cameras shall be color and the primary choice for monitoring following the activities described below. Pan/Tilt/Zoom (P/T/Z) cameras shall be color and are to be utilized to complement the fixed cameras.

3. Shall be powered over Ethernet. Network switches supporting PoE cameras shall have a back-up power source to ensure cameras are still operational in the event of loss of primary power to the VASS System.
4. Shall be rated for continuous operation under the environmental conditions listed in Part 1, Project Conditions.
5. Will be home run to a monitoring and recording device via a controlling device such as a matrix switcher or network server and monitored on a 24 hour basis at a designated Security Management System location.
6. Each function and activity shall be addressed within the system by a unique user defined name, with minimum of twenty (20) characters. The use of codes or mnemonics identifying the VASS action shall not be accepted.
7. Shall come with built-in video motion detection that shall automatically monitor and process information from each camera. The camera motion detection shall detect motion within the camera's field of view and provide automatic visual, remote alarms as a result of detected motion.
8. Shall be programmed to digitally flip from color to black and white at dusk and vice versa at low light conditions.
  - a. Will be fitted with AI/DC lenses to ensure the image quality under different light conditions.
  - b. P/T/Z cameras shall be utilized in a manner that they complement fixed cameras and shall not be used as a primary means of monitoring activity.
  - c. Dummy or fake cameras will not be utilized at any time.
  - d. Appropriate signage shall be designed, provided, and posted that notifies people that an area is under camera surveillance.

### **2.03 VIDEO MANAGEMENT SYSTEM (ANALOG)**

- A. The Video Management System (VMS) shall provide features and functions as specified below:
  1. Supports minimum of [20] client connections.
  2. The Video Management System shall be capable of recording more than [32] days on [1.6] TB of internal hard drive storage using the following parameters:
    - a. Resolution – 4CIF
    - b. Video Mode – NTSC
    - c. Quality – Normal
    - d. Sensitivity – Normal
    - e. Number of Cameras – 16
    - f. Record Audio – On
    - g. Motion [50%] .
  3. The Digital Video Management System shall, at a minimum, combine multiplexing, alarm detection, video motion detection, video, audio, and text recording.
- B. System Chassis
  1. The Video Management System must utilize a chassis no larger than [three] rack units in height, and be suitable for either desktop or rack mount installations. The unit must fit within a standard video rack as well as a server rack.
  2. The Video Management System's chassis shall include three indicator lights easily viewed from the front panel. These indicator lights must be colored red, yellow, and green to signify system status.
  3. The Video Management System's chassis shall incorporate a minimum of four front accessible, swappable drive bays. The bays must be behind a locking front cover that restricts access not only to the drives, but also to the power switch and reset switch.
- C. Operating System
  1. The Video Management System's operating system and application must be installed on a separate solid-state system drive (flash memory card), with no moving parts to wear out or fail, to reduce the risk of system failure. Units with the operating system and/or application

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installed on a hard drive are not acceptable.

D. Recording

1. The Digital Video Management System shall use record mode settings as continuous or event activated.
2. The Digital Video Management System shall provide for simultaneous recording, playback, transmitting, database searching and archiving.
3. One channel of audio and up to sixteen text inputs shall be supported with required hardware properly installed and set up according to manufacturer's instructions. Live audio shall be available for listening while viewing live video. Up to 15 cameras shall be configurable as visible or covert by the authorized user.//
4. The unit must simultaneously record, play back and archive video, text //and audio// while using sophisticated search functions to define and find only those important events that meet certain criteria. The system must also have the ability to host multiple remote users, archive data, and search for data, all while recording multiple video and text streams.
5. The Video Management System shall offer recording rates of up to 480 ips at 1CIF, 480 ips at 2CIF, and 480 ips at 4CIF. The unit shall be able to mix record speeds and quality settings on a "per camera" basis.
6. The Video Management System shall have the ability to capture critical information with higher frame rates for certain cameras, and assign the remainder of the available images per second (ips) to non-critical cameras.
7. The Video Management System shall be available with up to [4] insert number TB of internal hard drive storage. A RAID 5 version shall be available with up to [3] TB of internal hard drive storage.
8. The Video Management System's recording format must give each image a unique identification "stamp" to ensure even though the file structure is PC compatible, the original video images cannot be altered or modified, enabling a solid chain of evidence.
9. The Video Management System shall be able to store recorded video on the RAID Storage System (RSS) via an iSCSI interface.
  - a. The Video Management System shall be able to manage storage of video, audio and text by exporting to Network Attached Storage (NAS), Storage Area Network (SAN) and Direct Attached Storage (DAS) devices using optional software.
  - b. The system shall provide option to set up the Video Management System in advanced security mode to enable both IT and security managers to collectively integrate the unit into existing IT network without compromising the security protocols in place.

E. Network Access

1. The Video Management System shall provide network access through two internal network connections that support [1/10] GB network operation.

F. User Interface

1. The Video Management System's user interface must be easy to use, allowing the user to access all operations using one-click buttons, pull-down menus, adjustable sliders, and tabbed screens.
2. The Video Management System shall include the ability to accept text through a network connection, as well as through a serial input with an RS-232 connection. The unit shall be able to mix serial inputs and TCP/IP inputs in any combination up to 16 channels of text.
3. The system shall provide ability for user to specify text criteria, such as a specific ASCII text stream, to schedule recording and search for video, allowing for recording only the video associated with the specified text.

G. Live Video Display

1. The Digital Video Management System's live video display must provide real-time motion in any screen format (full, 2x2, 3x3, and 4x4). The operator shall have the ability to expand any view to full screen with a single click of the mouse.

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- H. Self-Monitoring Analysis
  - 1. The Digital Video Management System must incorporate Self-Monitoring Analysis and Reporting Technology (S.M.A.R.T.), incorporating a suite of advanced diagnostics that monitor the internal operation of a drive and provide early warning for many types of potential problems. This shall allow for the drive to be repaired or replaced before any data is lost or damaged.
- I. External Storage
  - 1. Using the integrated CD/DVD writer (CD-RW or DVD-RW), the Digital Video Management System shall allow users to save video, audio, and text to a standard recordable CD or DVD. The option to include the player software on the CD or DVD shall be available so that no additional software needs to be purchased. The unit must include the ability to export the latest video, audio, and text to a CD or DVD until the CD or DVD is full.
- J. Alarm Recording Settings:
  - 1. The Digital Video Management System shall allow for the following Alarm Recording settings:
    - a. Image Rate
    - b. Quality
    - c. Sensitivity
- K. Adjustable Alarm Duration
  - 1. The Digital Video Management System shall incorporate an adjustable alarm duration with the pre-alarm and minimum alarm duration programmable from five seconds to five minutes. The units must also allow programmable recording times (alarm schedules) for each day of the week, in thirty minute increments.
- L. Supported Dome Camera handlers
  - 1. The Digital Video Management System shall work with the following dome camera handlers: AD168, MP48, AD1024 matrix, VM96RTT, RS422 Dome Control, VM16/ADTT16, VM16E/ADTT16E, Pelco Matrix Switch (models 6700, 6800, 8500, 9500, 9750 or 9760 Pelco P, Pelco D, Bosh, Autodome, BBV Starcard and USB-CCTV.
- M. Alarm-Triggered Dome Events
  - 1. The Digital Video Management System must include alarm-triggered dome events, allowing the operator to configure domes to respond to alarm conditions via Network Client™ or Intellex GUI (using supported dome control handlers). The event can be a motion filter (motion detection, perimeter protection, light change and motion exception), a wired alarm, video loss, or a manually generated alarm. The unit must have the ability to move a single dome, or multiple domes, to preset positions or patterns. This feature must be supported by the dome.
- N. Email Support
  - 1. The Digital Video Management System must include the ability to send an email via an email server to anyone, or any group, based upon an event. The events must include, but not necessarily limited to, the following:
    - a. System Event
    - b. Video Loss
    - c. Generated Alarm
    - d. Any Filter Alarm
    - e. Any Input Alarm
    - f. Individual Camera Alarm
- O. API Support
  - 1. The Digital Video Management System shall easily integrate with third party software application using an Application Programmers Interface (API). The manufacturer of the unit shall offer a Software Developers Kit (SDK) to select third party manufactures, in addition to sample modular programs with their source codes in both Visual Basic and

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- Visual C++, allowing programmers to develop their own software to control the unit's functions.
2. The Digital Video Management System's API must be backwards compatible with previous versions of the software equal to or greater than v3.2
- P. Recorded Event Search
1. In order to instantly retrieve recorded video of any event, the Digital Video Management System shall use a patented search feature to filter through hours of video to find only the essential events. The operator must have the ability to isolate video containing motion, and find video where perimeters were crossed, lights were turned on or off, alarms were triggered, and numerous additional scenarios.
  2. In addition to the standard motion based mode, using advanced video analysis tools, the Digital Video Management System shall enable the user to schedule recording and search for video if the movement of an object meets specified size, speed, direction and Motion Exception criteria.
- Q. Covert Camera Operation:
1. The Digital Video Management System shall include the ability to configure up to 15 cameras for "covert" operation, restricting their use to only those who are authorized.
- R. Activity Log:
1. To provide for more effective security management, the Digital Video Management System must also allow for audits of the activity log to monitor changes to the settings and configurations. The activity log shall include, but not necessarily be limited to, the following information:
    - a. User Name – Login name of the user
    - b. Date/Time – Date and Time the action was performed
    - c. Access Loc – Whether the action was local to the unit or done through remote software
    - d. Category – The actions category
    - e. Activity – The action performed within the category
    - f. Data – Description of the action
  2. The operator shall have the ability to export the entire log file, export the displayed log file, print the log file, or print the displayed log file locally and remotely through Network Client v4.3 software.
- S. Antivirus Protection
1. The Digital Video Management System shall be compatible with the leading brands of anti-virus software in order to detect and deactivate malicious software that may attempt to attack the system.
- T. Remote Configuration and Management software:
1. The Digital Video Management System must include support for Remote Configuration and Management software to allow a user to remotely configure the unit, view live video, or select video segments by time, date, alarm, or search results. The operator must have the ability to save, annotate, and organize copied video into "incident folders" to aid with investigations.
  2. The remote management software must allow for up to 64 live video sessions, allowing the operator to view up to sixty four different cameras, from up to 64 different remote sites, simultaneously.
  3. The remote management software shall also allow the exporting of video clips to an .avi file to play on any Microsoft Windows based PC. The software shall have the ability to enhance, print, or convert the individual images to standard formats.
  4. The remote management software shall allow an operator to select units, cameras, and timeframes for automatic retrieval of video clips to an operators PC. This allows for downloads to be scheduled during times that network traffic restrictions are not an issue.
- U. Playback and Multi-screen Playback

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1. The Digital Video Management System shall incorporate playback and multi-screen playback functionality to allow the user to locate and select a single stored image to be enhanced using tools. The tools shall include, but not necessarily be limited to, the following:
  - a. Brightness
  - b. Contrast
  - c. Hue
  - d. Saturation
  - e. Lightness
  - f. Balance Light
  - g. Edge Detect
  - h. Enhance Light
  - i. Noise Reduction
  - j. Sharpen
  - k. Sharpen More
  - l. Smooth
  - m. Smooth More
  - n. Brightness Chart

V. Browser Client

1. A browser-based viewer (Browser Client) must also be available free of charge, enabling users to host and customize their own website to provide live viewing of the Digital Video Management System through a standard browser interface. Multiple viewers shall have the ability to access video and control domes remotely.

W. Minimum Performance Specifications

Power Supply	100-240 VAC, 50/60 Hz, 3.0/1.5A
Physical Characteristics:	Rack Mount Chassis Version Unit Dimensions (HxWxD) 130 mm (5.125") High , 429 mm (16.895") Wide, 546 mm (21.5") Deep Rack Height Three (3) units Desktop Chassis Version(HxWxD) 130 mm (5.125") High429 mm (16.895") Wide546 mm (21.5") Deep
Environmental Requirements	Operating Temperature 5° to 35° C (41° to 95° F) Humidity 5%-95% RH non-condensing
Regulatory	Immunity EN50130-4 (1996) (An Uninterruptable Power Supply must be used to fully comply with EN50130-4)

X. MATRIX SWITCHER

1. The matrix switcher shall meet the following minimum requirements:
  - a. Take multiple camera inputs and route them to multiple monitoring stations.
  - b. Allow for centralized user management controlling configurations.
  - c. Provide live viewing of all cameras.
  - d. Provide P/T/Z, focus, and iris control of all unitized cameras.
  - e. Be expandable to allow for the addition of multiple cameras and monitoring stations over the life of the system visual identification system by utilizing input and output video and controller cards.
  - f. Input cards shall allow for the addition of a minimum of four (4) camera inputs per card.

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- g. Output cards shall allow for the addition of a minimum of eight (8) outputs per card.
- h. Have the ability to be programmed either locally or remotely.
- i. Remotely operate multiple cameras from multiple stations.
- j. Be able to fully interface with a digital video recorder (DVR) for recording of all events.
- k. Utilize RS-232 or fiber optic connections for integration with the SMS computer station via a remote port on a network hub.
- l. Shall have an alarm interface that is compatible with all associated security subsystems. Alarm inputs shall be via either a relay or an EIA ANSI/EIA/TIA-232-F interface. The interface shall allow for a minimum of 24 alarm inputs and 12 alarm outputs.
- m. The switcher response time to an alarm input shall not be less than 200 milliseconds from the time an alarm is sensed until a picture is displayed on a monitor.
- n. The switcher shall have a built in buffer to allow for back-log of alarms. These alarms shall be viewable by an operator.
- o. Be addressable in the event multiple matrix switchers are connected to the SMS.
- p. Be configured, i.e. camera names, monitor names, sequences, alarms and alarm actions, etc. utilizing the configuration program and tools provided by the matrix manufacturer.

2. The matrix switcher shall meet the following minimum input/output requirements:

Camera inputs	16
Video outputs	4
Keyboard/Controller Outputs	4
Alarm inputs	323

3. The matrix switcher will have the following components and technical characteristics:

a. Main Unit:

Functions	Monitor control Camera selection, tour sequence, group sequence, group preset, OSD display, Camera/Receiver control via coaxial or RS-485 cable communication, Recorder control
Alarm control	Alarm event, Alarm Acknowledge, Alarm reset, Alarm suspension, Alarm History Display, Timer event, and Camera event
RS-485 (Camera)Port	6-conductor modular jack x 12 (2- wire or 4-wire communication, With termination switches (MODE 1 to 4))
Extension Port	6-conductor modular jack x 2(With a (EXTENSION 1 IN, OUT) termination switch (TERM: ON, OFF))
Extension Port	37-pin D-sub connector x 2(EXTENSION IN 2 or 3)
Extension Port	37-pin D-sub connector x 2(EXTENSION OUT 2 or 3)

b. Input Board:

Camera Input	1 V [P-P]/75 Ohm (BNC), composite video signal 0.5 V [P- P]/75 Ohm data signal and 2.5 V [P-P]/75 Ohm (25 pin D sub
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	connector x 4)
Alarm Input	N.O. (Normally Open contact) or N.C. (Normally Close contact) selectable x 32 (37 pin D sub connector)

c. Output Board:

Monitor Output	1 V [P-P]/75 Ohm (BNC)
Alarm Output	Open collector output x 32, Max. 24 VDC, 100 mA
Extension Port	6-conductor modular jack x 2
Serial Port	9-pin D-sub connector x 2

Y. IP Network Encoder

1. The units shall be used for video monitoring and surveillance over IP networks. IP Network Encoder shall encode analog video to MPEG-4 digital video.
2. The encoder shall use MPEG-4 compression for distribution of images over a network.
3. The encoder shall be [rack][surface] mounted unit.
4. The encoder shall include, but not be limited to the following:
  - a. The encoder shall use “hybrid” technology in providing both analog and network connections with the purpose of allowing users to integrate existing equipment and digital IP products.
    - 1) The encoder shall provide [one] composite video input(s).
    - 2) The encoder shall provide one Ethernet connection.
  - b. The encoder shall have the following digital resolution:
    - 1) D1: 720x576 (NTSC); 720x480 (PAL)
    - 2) CIF: 352 x 288 (NTSC); 352 x 240 (PAL)
    - 3) QCIF: 160 x 144 (NTSC); 160 x 112 (PAL)
  - c. The encoder shall have a digital frame rate of up to 30 frames per second (NTSC) at 720x480 resolution or 25 fps (PAL) at 720x586 resolution.
  - d. The encoder/decoder shall use the following protocols:
    - 1) TCP/IP
    - 2) UDP/IP
    - 3) DHCP
    - 4) Multicast
    - 5) Data Throttle
    - 6) Heart beat
  - e. The encoder shall have the following connectors:
    - 1) Power connector: 3-pin male – for connecting the external power supply
    - 2) I/O connector: 16-pin male – for connecting alarm, audio, RS-232, RS-485 input and output
    - 3) Video I/O connector: SVHS style – for input and output connection of two composite monitors
    - 4) Ethernet port: RJ-45 – for connecting to a network
  - f. The encoder/decoder shall have the following indicators:
    - 1) Power LED
    - 2) Link – indicates activity on the Ethernet port
    - 3) Tx activity
    - 4) Rx activity
  - g. The encoder shall have the following additional specifications:
    - 1) Video
      - (a) Video signal input: 1 V p-p ±10% 75 ohms, auto sensing
      - (b) Input termination: 75 ohm

- (c) Video compression standard: MPEG-4
- (d) Audio compression standard: MPEG-1 Layer 2
- 2) Audio
  - (a) Audio input: 315 mV, 40 kOhms, unbalanced
  - (b) Audio output: 315 mV, 600 ohms, unbalanced
- 3) Electrical
  - (a) External power supply: 100 to 240 VAC
  - (b) Output voltage: 13.5 V, 1.33 A
  - (c) Power consumption: 0.5 W maximum

## **2.04 DIGITAL BASED VIDEO MANAGEMENT SYSTEM**

### **A. Key Features**

1. Open Platform: Open API/SDK, supports seamless integration with third party applications.
2. Multi-server and multi-site video surveillance solution: Unlimited recording of video from IP cameras, IP video encoders and selected DVRs with analog cameras.
3. Optimized Recording Storage Management: Unique data storage and archiving solution that combines superior performance and scalability and cost efficient long-term video storage
4. Wide IP camera and device support: Supports connection of more than 839 IP cameras, IP video encoders and selected DVR models from over 79 different vendors through dedicated device integration
5. ONVIF™ and PSIA compliant: Supports ONVIF™ and PSIA compliant cameras and devices
6. Wide compression technology support: Supports the news compression methods; MPEG4 ASP, MxPEG and H.264, besides MJPEG and MPEG4
7. System configuration wizards: Guides the user through the process of adding cameras, configuring video and recording, adjustment of motion detection and user configuration
8. Sequence Explorer: Displaying sequences and time intervals in thumbnail pre-views, the Sequence Explorer gives unparalleled visual overview of recorded video combined with smooth navigation
9. Overlay buttons: Intuitive control of cameras, camera-integrated devices and other integrated systems- directly from the camera view
10. Independent Playback: Instant and independent playback function allows you to independently playback recorded video for one or more cameras, while in live viewing or playback mode
  - a. Built-in Video Motion Detection: Independent of camera model and supporting up to 64 cameras simultaneously per server
  - b. Multiple language support: Let operators use the system in their native language with support for 20 different languages
  - c. Multi-channel, two-way audio: Communicate with people at gates/entrances or broadcast messages to many people at once with multichannel, two-way audio
  - d. Fast evidence export: Quickly deliver authentic evidence to public authorities by exporting video to various formats, including video from multiple cameras with viewer, logs, and user notes included

### **B. Administration Features**

1. Single Management Application: A new Management Application provides a consolidated single point management access to Recording Servers.
2. System configuration wizards: Guides the user through the process of adding cameras, configuring video and recording, adjustment of motion detection and user configuration.
3. Automated device discovery: Enables fast discovery of camera devices using methods such as Universal Plug And Play, Broadcast and IP Range scanning.

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4. Smart bulk configuration option: Change settings across multiple devices simultaneously and in a very few clicks.
  5. Adaptable application behavior: Guides novice users, while expert users can optimize the application for efficient use.
  6. Export/import of system and user configuration data: System backup for reliable system operation and fast system recovery. System cloning for efficient rollout of multiple systems with the same, or similar, configuration.
  7. Import of off-line configuration data: Enabling off-line editing of configuration data, including camera and device definitions.
  8. Automatic system restore points: A 'Restore Point' is created each time a configuration change is confirmed.
  9. Enables easy rollback to previously defined system configuration points and enables cancelation of undesired configuration changes and restoration of earlier valid configurations.
- C. Integration Options
1. Open Software Development Kit (SDK) makes it possible to video enable your business processes, through seamless integration of third party applications, such as video analytics, access systems, etc.
  2. Compatible with Central for alarm overviews and operational status in larger video surveillance installations.
  3. Integrate with physical access control systems, alarms, gates, building management systems, etc. using hardware I/O, internal events and TCP/IP events
  4. Create, import and use HTML pages for navigation between views or to trigger a Smart Wall preset
  5. Develop third party plug-ins for the Smart Client to expand with new functionality
- D. Server Modules
1. Recording Server
    - a. Simultaneous digital multi-channel video and audio recording and live viewing (relaying).
    - b. Two-way audio enables integrated control of microphones and speakers connected to IP devices.
    - c. Bandwidth optimized multi-streaming by splitting a single camera video stream to differentiated streams for live view and recording, where each can be optimized independently with respect to frame rate and resolution.
    - d. Connectivity to cameras, video encoders and selected DVRs supports MJPEG, MPEG4, MPEG4 ASP\*, H.264\* and MxPEG.
    - e. Auto-detect camera models during setup.
  2. Flexible multi-site, multi-server license structure charged per camera.
  3. Unlimited number of installed cameras; simultaneous recording and live view of up to 64 cameras per server.
  4. Recording technology: secure high speed database holding JPEG images or MPEG4 and MxPEG streams including audio.
  5. Recording speed: 30+ frames per second per camera, limited only by hardware.
  6. Recording quality depends entirely on camera and video encoder capabilities: no software limitation.
  7. Start cameras on live view requests from clients.
  8. Unlimited recording capacity with multiple archives possible per day.
  9. Hourly to daily database archiving with optional automatic move to network drive saves storage capacity on the local server – with images still available transparently for playback
  10. Built-in, real-time, camera independent motion detection (VMD); fully adjustable sensitivity, zone exclusions, recording activation with frame rate speed up, and alert activation through email or SMS.

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11. Start recording on event.
    - a. Client initiated start of recording based on pre-defined recording time and access privileges.
    - b. Pan Tilt Zoom (PTZ) preset positions, up to 50 per camera.
    - c. Absolute\* and relative PTZ positioning.
    - d. PTZ go-to preset position on events.
    - e. Combine PTZ patrolling and go-to positions on events.
    - f. Set multiple patrolling schedules per camera per day: i.e. different for day/night/weekend.
    - g. PTZ scanning on supported devices: viewing or recording while moving slowly between PTZ positions.
  12. VMD-sensitive PTZ patrolling among selected presets allows sending of Wipe and Wash commands to supported PTZ models.
  13. On pre-defined events Matrix remote commands are automatically sent to display live video remotely on computers running the Matrix Monitor or the Smart
    - a. Client with Matrix Plug-in.
    - b. Flexible notification (sound, e-mail and SMS) and camera patrolling scheduling, triggered by time or event.
- E. Recording Server Manager
1. Local console management of the Recording Server accessible from the notification area.
  2. Start and stop Recording Server service.
  3. Access to Recording Server configuration settings.
  4. Access to Recording Server help system.
  5. View system status and log information.
- F. Image Server
1. Remote access for Smart and Remote Clients.
  2. Built-in web server for download and launch of clients and plug-ins.
  3. Set up one Master and multiple Slave Servers.
  4. Authenticate access based on Microsoft Active Directory user account, or user name and password.
  5. Authorize access privileges per Microsoft Active Directory user account/group, user profile or grant full access.
  6. User profiles control access to: Live view, PTZ, PTZ presets, Output control, Events, Listen to microphone, Talk to speaker, Manual recording; Playback, AVI export, JPG export, DB export, Sequences, Smart Search and audio. As well as Set up views, Edit private views and Edit shared public views.
  7. Audit logs of exported evidence by user and file.
  8. Audit logs of client user activity by time, locations and cameras.
- G. Recording Viewer
1. Playback recorded video and audio locally on the
- H. Recording Server.
1. View up to 16 cameras time-synched during playback.
  2. Scrollable activity timeline with magnifying feature.
  3. Instant search on recordings based on date/time and activity/alarm (Video Motion Detection).
  4. 'Smart Search' for highlighted image zones and objects.
  5. Evidence can be generated as a printed report, a JPEG image, an AVI film or in the native database format.
  6. Export audio recordings in WAV or AVI format.
  7. Export video digitally zoomed to view area of interest only and to minimize export footprint size.

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8. Export 'Evidence CD' containing native database and Recording Viewer for instant, easy viewing by authorities.
  9. Encryption & password protection option for exported recordings and files.
  10. Ability to add comments to exported evidence, also encrypted.
  11. Option to send email.
  12. De-interlacing of video from analog cameras.
  13. IPIX technology for PTZ in 360° recorded images.
- I. PDA Server
1. Remote access for PDA Client.
  2. Handle login and session requests between PDA clients and Image Server.
  3. Resize video surveillance images to fit the screen layout of PDA Client.
- J. Smart Client Module
1. Smart Client includes all the features of Remote Client plus more:
  2. Installed per default on Recording Server for local viewing and playback of video and audio.
  3. Start recording on cameras for a pre-defined time (default 5 minutes). Subject to privileges set by administrator.
  4. Independent Playback capability allows for instant playback of recorded video for one or more cameras, while in live and playback mode
  5. Live view digital zoom allows zoomed-out recordings while the operator digitally can zoom in to see details.
  6. 'Update On Motion Only' optimizes CPU usage by letting motion detection control whether the image should be decoded and displayed or not. The visual effect is a still image in the view until motion is detected.
  7. Shared and private camera views offer 1x1 up to 10x10 layouts in addition to asymmetric views.
  8. Views optimized for both 4:3 and 16:9 screen ratios.
  9. Multiple computer monitor support with a main window and any number of either windowed or full screen views.
  10. Hotspot function for working in details with a camera selected from a view containing multiple cameras.
  11. Carousel function allows a specified view to rotate between pre-defined cameras with individual timing and order with multiple appearances. Carousel function can be controlled allowing the operator to pause carousel function and to switch to previous or next camera.
  12. Overlay buttons provides intuitive control of cameras, camera-integrated devices and other integrated systems- directly from the camera view
  13. Matrix function to view live video from multiple cameras through the Image Server in any view layout with customizable rotation path, remotely controlled by Smart
  14. Clients or Recording Servers sending Matrix remote commands
  15. Send Matrix remote commands to display live video remotely on computers running the Matrix Monitor or the Smart Client with Matrix Plug-in.
  16. Cameras' built-in audio sources available in live and in playback.
  17. Separate pop-up window displaying sequences and time intervals in thumbnail pre-views, the Sequence Explorer gives unparalleled visual overview of recorded video combined with smooth navigation
  18. Presents recorded sequences for individual cameras, or all cameras in a view
  19. Seamlessly available in both Live and Playback modes
  20. Smooth navigation with sliding preview and "drag-and-throw" function for video thumbnails
  21. Instant playback of video sequences
  22. Application Options allows users to adapt the layout and personalize the application to their particular preferences
- K. Remote Client

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1. View live video or playback recordings for 1-16 cameras simultaneously; from the same or different servers.
  2. Advanced video navigation including fast/slow playback, jump to date/time, single step and video motion search.
  3. Individual views can be user-defined in various layouts: view or playback camera images from multiple servers simultaneously in the same view.
  4. Shared views can be managed centrally via the server with admin/user rights and user groups.
  5. Import static or active HTML maps for fast navigation to cameras and good premise overviews.
  6. Control output port relay operation, for example control of gates.
  7. Quick overview of sequences with detected motion and preview window.
  8. Quick overview of events/alerts.
  9. Control PTZ cameras remotely, also using preset positions.
  10. Remote PTZ Point-and-Click control
  11. Remote PTZ zoom to a marked rectangle.
  12. Take manual control over a PTZ camera that runs a patrolling scheme; after a timeout with no activity the camera reverts to its scheduled patrolling.
  13. IPIX 1x2 or 2x2 'Quad View' for viewing all 360° at once.
  14. Optional video compression in streaming from server to client gives better use of bandwidth.
  15. Create AVI files or save JPEG images.
  16. Print incident reports with free-text user comments.
    - a. System logon using user name and password.
  17. System logon using Microsoft Active Directory user accounts.
- L. PDA Client
1. View live or playback video from a single server or from multiple servers in half-screen or full-screen formats.
  2. In live view you can control Pan/Tilt/Zoom cameras manually or use preset positions, and control the cameras' output relays to trigger external actions like opening doors or gates, turning on lights, etc.
  3. To find recordings, you can jump to specific time/date or to next detected motion, or use motion detection sequence overviews.
  4. When viewing recordings, you can playback at variable speed or single step image by image.
  5. The PDA client shall connect to the VMS server using any IP connection; typically wireless LAN, GPRS, etc.
  6. Video compression from the server to PDA optimizes bandwidth usage.
  7. System logon using user name and password.
- M. Matrix Monitor
1. Virtual Matrix showing live video directly from up to 4 cameras at a time triggered remotely by Matrix remote commands.
  2. Camera view shifts by FIFO (first-in-first-out)
  3. Multiple events can control a single Matrix monitor and single events can control multiple monitors.
- N. Minimum System Requirements VMS Server
1. HW Platform:
    - a. Minimum 2.4 GHz CPU and 1 GB RAM (2.4 GHz dual core processor and 2 GB RAM or more recommended).
    - b. Minimum 1 GB disk space available, excluding space needed for recordings.
  2. OS:

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- a. Microsoft® Windows® XP Professional (32 bit or 64 bit\*), Windows Server 2003 (32 bit or 64 bit\*), Windows Server 2008 R1/R2 (32 bit or 64 bit\*), Windows Vista™ Business (32 bit or 64 bit\*), Windows Vista Enterprise (32 bit or 64 bit\*), Windows Vista Ultimate (32 bit or 64 bit\*), Windows 7 Professional (32 bit or 64 bit\*), Windows 7 Enterprise (32 bit or 64 bit\*) and Windows 7 Ultimate (32 bit or 64 bit\*).
3. Software:
  - a. Microsoft .NET 3.5 Framework SP1, or newer.
  - b. DirectX 9.0 or newer required to run Playback Viewer application.
- O. Minimum System Requirements PDA Server
  1. HW Platform:
    - a. Minimum 2.4 GHz CPU and 1 GB RAM (2.4 GHz dual core processor and 2 GB RAM or more recommended).
    - b. Minimum 1 GB disk space available.
  2. OS:
    - a. Microsoft Windows XP Professional (32 bit or 64 bit\*), Windows Server 2003 (32 bit or 64 bit\*).
  3. Software:
    - a. Microsoft .NET 2.0 (not compatible with newer versions). Internet Information Server (IIS) 5.1.
- P. Minimum System Requirements VMS Client
  1. HW Platform:
    - a. Minimum 2.4 GHz CPU, 1 GB RAM (more powerful CPU and higher RAM recommended for Smart Clients running high number of cameras and multiple views and displays).
  2. Graphics Card:
    - a. AGP or PCI-Express, minimum 1024 x 768 (1280 x 1024 recommended), 16 bit colors.
  3. OS:
    - a. Microsoft Windows XP Professional (32 bit or 64 bit\*), Windows Server 2003 (32 bit or 64 bit\*), Windows Server 2008 R1/R2 (32 bit or 64 bit\*), Windows Vista Business (32 bit or 64 bit\*), Windows Vista Enterprise (32 bit or 64 bit\*), Windows Vista Ultimate (32 bit or 64 bit\*), Windows 7 Professional (32 bit or 64 bit\*), Windows 7 Enterprise (32 bit or 64 bit\*) and Windows 7 Ultimate (32 bit or 64 bit\*).
    - b. Microsoft Windows XP Professional (32 bit or 64 bit\*), Windows Server 2003 (32 bit or 64 bit\*), Windows Server 2008 R1/R2 (32 bit or 64 bit\*), Windows Vista Business (32 bit or 64 bit\*), Windows Vista Enterprise (32 bit or 64 bit\*), Windows Vista Ultimate (32 bit or 64 bit\*), Windows 7 Professional (32 bit or 64 bit\*), Windows 7 Enterprise (32 bit or 64 bit\*) and Windows 7 Ultimate (32 bit or 64 bit\*).
  4. Software:
    - a. DirectX 9.0 or newer required to run Playback Viewer application.
    - b. Microsoft .NET 3.5 Framework SP1, or newer.
- Q. Minimum System Requirements VMS Remote Client
  1. HW Platform:
    - a. Minimum 2.4 GHz CPU, RAM 1 GB (2 GB or higher recommended on Microsoft Windows Vista).
  2. OS:
    - a. Microsoft Windows XP Professional (32 bit or 64 bit\*), Windows Server 2003 (32 bit or 64 bit\*), Windows Server 2008 R1/R2 (32 bit or 64 bit\*), Windows Vista Business (32 bit or 64 bit\*), Windows Vista Enterprise (32 bit or 64 bit\*) and Windows Vista Ultimate (32 bit or 64 bit\*), Windows 7 Professional (32 bit or 64 bit\*), Windows 7 Enterprise (32 bit or 64 bit\*) and Windows 7 Ultimate (32 bit or 64 bit\*).
  3. Software:
    - a. DirectX 9.0 or newer required to run Playback Viewer Application Microsoft Internet Explorer 6.0, or newer, 32 bit version required
- R. Licensing Structure
  1. Base Server License

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- a. An VMS Base Server license is mandatory for installing the product.
  2. The Base Server license contains:
    - a. Unlimited numbers of Recording Server licenses
    - b. Unlimited numbers of Smart Clients, Remote Clients, PDA Clients and Matrix Monitor licenses
  3. Camera License
    - a. To connect to a camera, a Device License per camera channel is required
    - b. In total, for all copies of the product installed under a given Base Server license, the product may only be used with as many cameras as you have purchased camera licenses for • Video encoders and DVRs with multiple analog cameras require a license per channel to operate
    - c. Camera Licenses can be purchased in any numbers. To extend the installation with additional Camera Licenses, the Base Server License number (SLC) is required when ordering.
  4. Client License:
    - a. All client modules are not licensed and can be installed and used on any number of computers.
- S. IP NETWORK DECODER
1. The unit shall be used for video monitoring and surveillance over IP networks. Network decoder shall decode MPEG-4 digital video to analog video.
  2. The decoder shall use MPEG-4 compression for efficient distribution of images over a network.
  3. The decoder shall be available as a standalone unit that can be horizontally or vertically mounted.
  4. The decoder shall include, but not be limited to the following:
    - a. The decoder shall use “hybrid” technology in providing both analog and network connections with the purpose of allowing users to integrate existing equipment and digital IP products.
      - 1) The decoder shall provide one composite video input and output connection.
      - 2) The decoder shall provide one Ethernet connection.
    - b. The decoder shall have the following digital resolution:
      - 1) D1: 720x576 (NTSC); 720x480 (PAL)
      - 2) CIF: 352 x 288 (NTSC); 352 x 240 (PAL)
      - 3) 3) QCIF: 160 x 144 (NTSC); 160 x 112 (PAL)
    - c. The decoder shall have a digital frame rate of up to 30 frames per second (NTSC) at 720x480 resolution or 25 fps (PAL) at 720x586 resolution.
    - d. The decoder shall use the following protocols:
      - 1) TCP/IP
      - 2) UDP/IP
      - 3) DHCP
      - 4) Multicast
      - 5) Data Throttle
      - 6) Heart beat
    - e. The decoder shall have the following connectors:
      - 1) Power connector: 3-pin male – for connecting the external power supply
      - 2) I/O connector: 16-pin male – for connecting alarm, audio, RS-232, RS-485 input and output
      - 3) Video I/O connector: SVHS style – for input and output connection of two composite monitors
      - 4) Ethernet port: RJ-45 – for connecting to a network
    - f. The decoder shall have the following indicators:
      - 1) Power LED



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- 2) Link – indicates activity on the Ethernet port
- 3) Tx activity
- 4) Rx activity
- 5. The decoder shall have the following additional specifications:
  - a. Video
    - 1) Video signal output: 1 V p-p into 75 ohms
    - 2) Input termination: 75 ohm
    - 3) Video compression standard: MPEG-4
    - 4) Audio compression standard: MPEG-1 Layer 2
  - b. Audio
    - 1) Audio input: 315 mV, 40 kOhms, unbalanced
    - 2) Audio output: 315 mV, 600 ohms, unbalanced
  - c. Electrical
    - 1) External power supply: 100 to 240 VAC
    - 2) Output voltage: 13.5 V, 1.33 A
    - 3) Power consumption: 0.5 W maximum

**2.05 VIDEO DISPLAY EQUIPMENT**

- A. Video Display Equipment
  - 1. Will consist of color monitors and shall be EIA 375A compliant.
  - 2. Shall be able to display analog, digital, and other images in either NTSC or MPEG format associated with the operation of the Security Management System (SMS).
  - 3. Shall:
    - a. Have front panel controls that provide for power on/off, horizontal and vertical hold, brightness, and contrast.
    - b. Accept multiple inputs, either directly or indirectly.
    - c. Have the capabilities to observe and program the VASS System.
    - d. Be installed in a manner that they cannot be witnessed by the general public.

B. Color Video Monitors Technical Characteristics:

Sync Format	PAL/NTSC
Display Tube	90° deflection angle
Horizontal Resolution	250 TVL minimum, 300 TVL typical
Video Input	1.0 Vp-p, 75 Ohm
Front Panel Controls	Volume, Contrast, Brightness, Color
Connectors	BNC

- C. Liquid Crystal Display (LCD) Flat Panel Display Monitor
- D. The 17-inch color LCD monitor shall have a flat screen and 17-inch diagonal viewing area and consists of an LCD panel, bezel, and stand.
  - 1. The monitor shall meet or exceed the following specifications:
  - 2. The monitor shall incorporate a 17.1-inch active matrix TFT LCD panel.
    - a. The pixel pitch of the monitor's LCD panel shall be 0.264 mm horizontal and 0.264 mm vertical.
    - b. The monitor shall have a maximum resolution of <500> television lines.
    - c. The contrast ratio shall be 500:1.
    - d. The typical brightness shall be 250 cd/m<sup>2</sup>
    - e. The monitor shall display at least 16.7 million colors.
    - f. The light source for the LCD panel shall have a lifetime of [50,000] hours.
    - g. The scan frequency horizontal shall be 30 K to 80 KHz and the scan frequency vertical shall be 56 to 75 Hz.

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- h. The viewing angle for the monitor shall be 170 degrees horizontal and 170 degrees vertical.
  3. The monitor shall have automatic NTSC or PAL recognition.
  4. The monitor shall have a picture-in-picture function.
  5. The monitor shall use the following signal connectors:
    - a. Video 1.0 V peak-to-peak at 75 ohms
    - b. BNC in/out
    - c. Y/C (S-video) in/out
    - d. Audio in/out
    - e. VGA 15-pin D-Sub
  6. The monitor shall have one or two audio speaker(s).
    - a. The speaker shall be 0.5 W minimum.
  7. The monitor shall have the following front control panel buttons:
    - a. Power on/off
    - b. LED indicator
    - c. Mode
    - d. Increase (volume)
    - e. Decrease (volume)
    - f. Up (contrast adjustment)
    - g. Down (brightness adjustment)
    - h. Menu
    - i. Auto
  8. The monitor shall have the following options for adjustment in an onscreen display menu:
    - a. Color
    - b. Tint
      - 1) NTSC mode only
        - (a) Brightness
        - (b) Contrast
        - (c) Sharpness
        - (d) Volume
        - (e) Language
        - (f) Scan
        - (g) Color Temp
        - (h) H-Position
        - (i) Recall
- E. The electrical specifications for the monitor shall be as follows:
1. Input voltage shall be 12 VDC/3 A.
  2. Power consumption shall be 50 W maximum.
- F. The environmental specifications for the monitor shall be as follows:
1. Operating temperature shall be 32 to 104 degrees Fahrenheit or 0 to 40 degrees Celsius.
  2. Operating humidity shall be 10 to 85 percent.
- G. The physical specifications for the monitor shall be as follows:
- H. The monitor shall conform to these compliance standards:
1. FCC
  2. CE (EMC/LVD)
  3. UL

## 2.06 CONTROLLING EQUIPMENT

- A. Shall be utilized to call up, operate, and program all cameras associated VASS System components.

- B. Will have the ability to operate the cameras locally and remotely. A matrix switcher or a network server shall be utilized as the VASS System controller.
- C. The controller shall be able to fit into a standard 47.5 cm (19 inch) equipment rack.
- D. Control and programming keyboards shall be provided with its own type of switcher. All keyboards shall:
  - 1. Be located at each monitoring station.
  - 2. Be addressable for programming purposes.
  - 3. Provide interface between the operator and the VASS System.
  - 4. Provide full control and programming of the switcher.
  - 5. Have the minimum following controls:
    - a. programming
    - b. switching
    - c. lens function
    - d. P/T/Z
    - e. environmental housing
    - f. annotation

## 2.07 VIDEO CAMERAS

- A. The cameras shall be high-resolution color video cameras with wide dynamic range capturing capability.
- B. The camera shall meet or exceed the following specifications:
  - 1. The image capturing device shall be a [1/3]/[1/4]-inch image sensor designed for capturing wide dynamic images.
    - a. The image capturing device shall have a separate analog-to-digital converter for every pixel.
    - b. The image capturing device shall sample each pixel multiple times per second.
    - c. The dynamic range shall be 95 dB typical and 120 dB maximum.
  - 2. The camera shall optimize each pixel independently.
  - 3. The camera shall have onscreen display menus for programming of the camera's settings.
  - 4. The signal system shall be NTSC.
- C. The camera shall have composite video output.
- D. The camera shall come with a manual varifocal lens.
- E. The video output shall be composite: 1.0 volts peak-to-peak at 75-ohm load.
- F. Fixed Color Camera
  - 1. The camera shall be a high-resolution color video camera with wide dynamic range capturing capability.
  - 2. Comply with UL 639.
  - 3. Pickup Device: [1/3]/[1/4] CCD interline transfer.
  - 4. Signal-to-Noise Ratio: Not less than 50 dB, with the camera AGC off.
  - 5. With AGC, manually selectable on or off.
  - 6. Manually selectable modes for backlight compensation or normal lighting.
  - 7. Scanning Synchronization: Determined by external synch over the coaxial cable. Camera shall revert to internally generated synchronization on loss of external synch signal.
  - 8. White Balance: Auto-tracing white balance, with manually selectable fixed balance option.
- G. Camera accessories shall include:
  - 1. Surface mount adapter
  - 2. Wall mount adapter
  - 3. Flush mount adapter
- H. Indoor/Outdoor Fixed Mini Dome System (IP)

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1. The indoor/outdoor fixed mini dome system shall include a built-in 100Base-TX network interface for live streaming to a standard Web browser.
2. The network mini dome shall be integrated into the back box design to accept multiple camera options without modification. The network mini dome shall operate in open architecture connectivity for third-party software recording solutions.
3. The indoor/outdoor fixed mini dome system shall meet or exceed the following design and performance specifications.

Imaging Device	1/3-inch imager															
Picture Elements	NTSC/PAL 720 (H) x 540 (V) 720 (H) x 540 (V)															
Dynamic Range	102 dB typical/120 dB maximum (DW/CW models only)															
Scanning System	2:1 interlace (progressive option on CW/DW models only)															
Synchronization	Internal															
Electronic Shutter Range	Auto (1/15–1/22,000)															
Lens Type	Varifocal with auto iris															
Format Size	1/3-inch															
Focal Length	3.0 mm–9.5 mm 9.0 mm–22.0 mm <list>															
Operation	Iris Auto (DC-drive) Focus Manual Zoom Manual															
Minimum Illumination	Color (day): 0.8 lux, SENS 8X: 0.2 lux, B-W (night): 0.08 lux, SENS 8X: 0.02 lux (F1.0, 40 IRE, AGC on, 75% scene reflectance) Color (day): 0.15 lux, B-W (night): 0.015 lux (F1.0, 40 IRE, AGC on, 75% scene reflectance) Color (day): 0.8 lux, SENS 8X: 0.2 lux (F1.0, 40 IRE, AGC on, 75% scene reflectance) 0.2 lux (F1.0, 40 IRE, AGC on, 75% scene reflectance)															
Compression	MPEG-4, MJPEG in Web viewing mode															
Video Streams	3, simultaneous															
Video Resolutions	<table border="1"> <thead> <tr> <th></th> <th>NTSC</th> <th>PAL</th> </tr> </thead> <tbody> <tr> <td>4CIF</td> <td>704 x 480</td> <td>704 x 576</td> </tr> <tr> <td>2CIF</td> <td>704 x 240</td> <td>704 x 288</td> </tr> <tr> <td>CIF</td> <td>352 x 240</td> <td>352 x 288</td> </tr> <tr> <td>QCIF</td> <td>176 x 120</td> <td>176 x 144</td> </tr> </tbody> </table>		NTSC	PAL	4CIF	704 x 480	704 x 576	2CIF	704 x 240	704 x 288	CIF	352 x 240	352 x 288	QCIF	176 x 120	176 x 144
	NTSC	PAL														
4CIF	704 x 480	704 x 576														
2CIF	704 x 240	704 x 288														
CIF	352 x 240	352 x 288														
QCIF	176 x 120	176 x 144														
Bit Rate	Configurable, 20 kbps to 2 Mbps per stream															
Web User Interface																
Environment	Low temperature, indoor/outdoor															
Connectors	RJ-45 for 100BASE-TX, Auto MDI/MDI-X															
Cabling	CAT5 cable or better for 100BASE-TX															
Input Voltage	24 VAC (18-36) or PoE input voltage															

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Power Consumption	<7.5 Watts, <13 Watts with heaters 24VAC: <0.5 Amps, <0.9 Amps with heaters
Alarm Input	10 VDC maximum, 5 mA maximum
Alarm Output	0 to 15 VDC maximum, 75 mA maximum
Service Connector	Internal to housing for 2.5 mm connector for NTSC/PAL video outputs
Service Connector	3-conductor, 2.5 mm connector for video output to optional (IS-SC cable)
Pan/Tilt Adjustment	Pan 360°, tilt 80° (20° to 100° range), and rotation 360°
Light Attenuation	smoked bubble, f/1.5 light loss; clear bubble, zero light loss
CERTIFICATIONS	CE, Class B UL Listed Meets NEMA Type 4X and IP66 standards

4. Accessories
  - a. Pendant mount
  - b. Wall mount for pendant
  - c. Corner adapter for wall mount
  - d. Pole adapter for wall mount
  
- I. Megapixel High Definition Integrated Digital Network Camera
  1. The network camera shall offer dual video streams with up to 3.1 megapixel resolution (2048 x 1536) in progressive scan format.
  2. An alarm input and relay output shall be built in for integration with hard wired external sensors.
  3. The network camera shall be capable of firmware upgrades through a network using a software-based device utility.
  4. The network camera shall offer auto back focus (ABF) functionality through a push button on the camera. ABF parameters shall also be configurable through a standard Web browser interface.
  5. The network camera shall offer a video output port providing an NTSC/PAL analog video output signal for adjusting field of view and focus at the camera.
  6. The network camera shall provide advanced low-light capabilities for color and day/night models with sensitivity down to 0.12 lux in color and 0.03 lux in black-white (B-W).
  7. The network camera shall have removable IR cut filter mechanism for increased sensitivity in low-light installations. The sensitivity of IR cut filter removal shall be configurable through a Web browser.
  8. The network camera shall support two simultaneous, configurable video streams. H.264 and MJPEG compression formats shall be available for primary and secondary streams with selectable unicast and multicast protocols. The streams shall be configurable in a variety of frame rates and bit rates.
  9. The network camera shall support industry standard Power over Ethernet (PoE)
  10. IEEE 802.3af to supply power to the camera over the network. The network camera shall also offer a 24 VAC power input for optional use.
  11. The network camera shall use a standard Web browser interface for remote administration and configuration of camera parameters.
  12. The network camera shall have a window blanking feature to conceal user-defined privacy areas that cannot be viewed by an operator. The network camera shall support up to four blanked windows. A blanked area shall appear on the screen as a solid gray window.
  13. The network camera shall support standard IT protocols.

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14. The network camera shall support open architecture best practices with a published API available to third-party network video recording and management systems.
15. Megapixel High Definition Integrated Digital Network Camera Technical Specifications:

Imaging Device	1/3-inch, effective
Imager Type	CMOS, Progressive scan
Maximum Resolution	2048 x 1536
Signal-to-Noise Ratio	50 dB
Auto Iris Lens Type	DC drive
Electronic Shutter Range	1~1/100,000 sec
Wide Dynamic Range	60 dB
White Balance Range	2,000° to 10,000°K
Sensitivity	f/1.2; 2,850K; SNR >24dB Color (1x/33ms) 0.50 lux Color SENS (15x/500 ms) 0.12 lux Mono SENS (15x/500 ms) Mono (1x/33ms)0.25 lux 0.03 lux
Dome Attenuation	Clear Zero light loss Smoke f/1.0 light loss
Compression	H.264 in base profile and MJPEG
Video Streams	Up to 2 simultaneous streams, the second Stream variable based on the setup of the primary stream
Frame Rate	Up to 30, 25, 24, 15, 12.5, 12, 10, 8, 7.5, 6.5, 4, 3, 2, and 1 (depending upon coding, resolution, and stream configuration)
Available Resolutions	3.1 MPx2048 x 1536; 4:3 aspect ratio; 2.0 ips max., 10.0 Mbps bit rate for MJPEG; 3.0 ips max., 2.6 Mbps bit rate H.264 2.1 MPx1920 x 1080; 16:9 aspect ratio: 15.0 ips max.,10.0 Mbps bit rate for MJPEG; 5.0 ips max., 2.7 Mbps bit rate H.264 3.1.9 MPx1600 x 1200; 4:3 aspect ratio; 15.0 ips max.,10.0 Mbps bit rate for MJPEG; 6.0 ips max., 2.6 Mbps bit rate H.264 1.3 MPx1280 x 1024; 5:4 aspect ratio; 15.0 ips max.,10.0 Mbps bit rate for MJPEG; 8.0 ips max., 2.5 Mbps bit rate H.264 1.2 MPx1280 x 960; 4:3 aspect ratio; 15.0 ips max., 9.8 Mbps bit rate for MJPEG; 9.8 ips max., 8.5 Mbps bit rate H.264 6.0.9 MPx1280 x 720; 16:9 aspect ratio; 30.0 ips max.,10.0 Mbps bit rate for MJPEG; 12.5 ips max., 2.5 Mbps bit rate H.264 0.5 MPx800 x 600; 4:3 aspect ratio; 30.0 ips max., 5.8 Mbps bit rate for MJPEG; 25.0 ips max., 2.0 Mbps bit rate H.264 8.0.3 MPx640 x 480; 4:3 aspect ratio; 30.0 ips max., 3.7 Mbps bit rate for MJPEG; 30.0 ips max.,1.6

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	Mbps bit rate H.264 0.1 MPx320 x 240; 4:3 aspect ratio; 30.0 ips max., 0.9 Mbps bit rate for MJPEG; 30.0 ips max., 0.4 Mbps bit rate H.264 Additional 640 x 512, 640 x 352, 480 x 368, 480 x 272, 320 x 256, 320 x 176
Supported Protocols	TCP/IP, UDP/IP (Unicast, Multicast IGMP), UPnP, DNS, DHCP, RTP, RTSP, NTP, IPv4, SNMP, QoS, HTTP, HTTPS, LDAP(client), SSH, SSL, STMP, FTP, MDNS(Bonjour), and 802.1x (EAP)
Security Access	Password protected
Software Interface	Web browser view and setup, up to 16 cameras
Connectors	RJ-45 for 100Base-TX, Auto MDI/MDI-X
Cable	Cat5 cable or better for 100Base-TX
Input Voltage	24 VAC or PoE (IEEE802.3af class 3)
Power Consumption	6 W
Current Consumption	PoE <200 mA maximum 24 VAC <295 mA nominal; <390 mA maximum
Alarm Input	10 VDC maximum, 5 mA maximum
Alarm Output	0 to 15 VDC maximum, 75 mA maximum
Lens Mount	CS mount, adjustable
Pan/Tilt Adjustment	Pan 368° Tilt 160° (10° to 170°) Rotate 355°

16. Accessories

- a. Pendant mount
- b. Wall mount for pendant
- c. Corner adapter for wall mount
- d. Pole adapter for wall mount

17. Recommended Lenses

- a. Megapixel lens, varifocal, 2.2~6.0 mm, f/1.3~2.0
- b. Megapixel lens, varifocal, 2.8~8.0 mm, f/1.1~1.9
- c. Megapixel lens, varifocal, 2.8~12.0 mm, f/1.4~2.7
- d. Megapixel lens, varifocal, 15.0~50.0 mm, f/1.5~2.1

J. Indoor/Outdoor Camera Dome System

1. The indoor/outdoor camera dome system shall include a built-in 100Base-TX network interface for live streaming to a standard Web browser.
2. The indoor/outdoor camera dome system shall operate in open architecture connectivity for third-party software recording solutions.
3. The indoor/outdoor VASS camera dome system shall be a discreet camera dome system consisting of a dome drive with a variable speed/high speed pan/tilt drive unit with continuous 360 degree rotation; 1/4-inch high resolution color, or color/black-white CCD camera; motorized zoom lens with optical and digital zoom; auto focus; and an enclosure consisting of a back box, lower dome, and a quick-install mounting.
4. Indoor/Outdoor fixed dome system technical specifications:

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Imaging Device	1/4-inch CCD
Picture Elements	NTSC/PAL 768 x 494/752 x 582
Dynamic Range	102 dB typical/120 dB maximum (DW/CW models only)
Scanning System	2:1 interlace
Synchronization	Internal
Electronic Shutter Range	Auto (1/15–1/22,000)
Lens Type	Lens f/1.4 (focal length, 3.4~119 mm; 35X optical zoom, 12X digital zoom)
Focus	Automatic with manual override
Pan Speed	Variable between 400□ per second continuous pan to 0.1° per second
Vertical Tilt	Unobstructed tilt of +2□ to -92□
Manual Control Speed	Pan speed of 0.1□ to 80□ per second, and pan at 150□ per second in turbo mode. Tilt operation shall range from 0.1□ to 40□ per second
Automatic Preset Speed	Pan speed of 400□ and a tilt speed of 200□ per second
Presets	256 positions with a 20-character label available for each position; programmable camera settings, including selectable auto focus modes, iris level, LowLight™ limit, and backlight compensation for each preset; command to copy camera settings from one preset to another; and preset programming through control keyboard or through dome system on-screen menu 128 positions with a 20-character label available for each position; programmable camera settings, including selectable auto focus modes, iris level, LowLight limit, and backlight compensation for each preset; command to copy camera settings from one preset to another; and preset programming through control keyboard or through dome system on-screen menu
Preset Accuracy	± 0.1□
Zones	8 zones with up to 20-character labeling for each, with the ability to blank the video in the zone
Limit Stops	Programmable for manual panning, auto/random scanning, and frame scanning
Alarm Inputs	7
Alarm Output Programming	Auxiliary outputs can be alternately programmed to operate on alarm
Alarm Action	Individually programmed for 3 priority levels,



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	initiating a stored pattern or going to a preassigned preset position
Resume after Alarm	After completion of alarm, dome returns to previously programmed state or its previous position
Window Blanking	8, four-sided user-defined shapes, each side with different lengths; window blanking setting to turn off at user-defined zoom ratio; window blanking set to opaque gray or translucent smear; blank all video above user-defined tilt angle; blank all video below user-defined tilt angle
Patterns	8 user-defined programmable patterns including pan/tilt/zoom and preset functions, and pattern programming through control keyboard or through dome system on-screen menu
Scheduler	Internal scheduling system for programming presets, patterns, window blanks, alarms, and auxiliary functions based on internal clock settings
Auto Flip	Rotates dome 180° at bottom of tilt travel
Password Protection	Programmable settings with optional password protection
Compass Display	On-screen display of compass heading and user-definable compass setup
Camera Title Overlay	20 user-definable characters on the screen camera title display
Video Output Level	User-selectable for normal or high output levels to compensate for long video wire runs
Motion Detection	User-definable motion detection settings for each preset scene, can activate auxiliary outputs, and contains three sensitivity levels per zone
Electronic Image Stabilization	Electronic compensation for external vibration sources that cause image blurring; user selectable for 2 frequency ranges, 5 Hz (3-7 Hz) and 10 Hz (8-12 Hz)
Wide Dynamic Range	128X
Video Output	1 Vp-p, 75 ohms
Minimum Illumination	NTSC/EIA 0.55 lux at 1/60 sec shutter speed (color), 0.063 lux at 1/4 sec shutter speed (color), 0.00018 lux at 1/2 sec shutter speed (B-W) PAL/CCIR 0.55 lux at 1/50 sec shutter speed (color), 0.063 lux at 1/3 sec shutter

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	speed (color), 0.00018 lux at 1/1.5 sec shutter speed (B-W)
Compression	MPEG-4, MJPEG
Video Streams	3, simultaneous
Video Resolutions	NTSC PAL
	4CIF 704 x 480 704 x 576
	2CIF 704 x 240 704 x 288
	CIF 352 x 240 352 x 288
	QCIF 176 x 120 176 x 144
Bit Rate	Configurable, MPEG-4 30 ips, 2 Mbps for primary stream, MJPEG 15 ips, 3 Mbps, MJPEG
Web User Interface	
Environment	Low temperature, indoor/outdoor
Connectors	RJ-45 for 100BASE-TX, Auto MDI/MDI-X
Cabling	CAT5 cable or better for 100BASE-TX
Input Voltage	18 to 32 VAC; 24 VAC nominal 22 to 27 VDC; 24 VDC nominal
Power Consumption	24 VAC 23 VA nominal (without heater);73 VA nominal (with heater) 24 VDC 0.7 A nominal (without heater);3 A nominal (with heater)
Alarm Input	7
Alarm Output	1
CERTIFICATIONS	CE, Class B UL Listed Meets NEMA Type 4X and IP66 standards

5. Accessories
  - a. Pendant mount
  - b. Wall mount for pendant
  - c. Corner adapter for wall mount
  - d. Pole adapter for wall mount

K. Reinforced Fixed Dome Camera

1. The dome camera shall be a high-resolution color video camera with wide dynamic range capturing capability.
2. The camera shall meet or exceed the following specifications:
  - a. The camera shall have the form factor as typical of a traditional VASS dome video camera.
  - b. The image capturing device shall be a 1/3-inch image sensor designed for capturing wide dynamic images.
3. The camera shall optimize each pixel independently.
4. The camera shall have onscreen display menus for programming of the camera's settings.
5. The signal system shall be NTSC or PAL selectable.
6. The resolution that the camera provides shall be [470] television lines horizontal and [460] television lines vertical.
7. The camera shall have [720] horizontal and 540 vertical picture elements.
8. The scanning system shall be 525/60 lines NTSC or 625/50 lines PAL.
9. The synchronizing system shall be internal/AC line-lock.

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10. The sensitivity shall be 0.6 lux at f1.2, 30 IRE.
11. The signal-to-noise ratio shall be 50 dB.
12. The electronic shutter shall have automatic adjustment, and operate from 1/60 NTSC to 1/100,000 second, automatic.
13. The camera shall have an automatic white balance range of 2800 to 11000 K.
14. The camera shall have automatic gain control.
15. The camera shall include a shroud to conceal the camera's position inside the dome.
16. The camera shall have composite video output.
17. The housing shall have the following specifications:
  - a. Construction: Aluminum
  - b. The housing shall be heavy duty and tamper resistant.
  - c. Dome housing construction: 0.13-in polycarbonate.
  - d. Finish: Powder coat
18. The camera shall come with a manual varifocal [4 to 9] mm lens.
19. The electrical specifications for the camera shall be as follows:
  - a. Input voltage shall be 24 VAC or 12 VDC.
  - b. Power consumption shall be 12 VDC, 455 mA; or 24 VAC, 160 mA.
  - c. Power source shall be universal 18 to 30 VAC or 10 to 30 VDC.
  - d. Video output shall be composite: 1.0 volts peak-to-peak at 75-ohm load.
20. The environmental specifications for the camera shall be as follows: Operating temperature shall be -10 to 45 degrees Celsius or 14 to 113 degrees Fahrenheit.
21. Accessories shall include:
  - a. Surface mount adapter
  - b. Wall mount adapter
  - c. Flush mount adapter

L. Indoor/Outdoor Fixed Mini Dome System

1. The indoor/outdoor fixed mini dome system shall include a built-in 100Base-TX network interface for live streaming to a standard Web browser.
2. The network mini dome shall be integrated into the back box design to accept multiple camera options without modification. The network mini dome shall operate in open architecture connectivity for third-party software recording solutions.
3. The indoor/outdoor fixed mini dome system shall meet or exceed the following design and performance specifications.

Imaging Device	1/3-inch imager
Picture Elements	NTSC/PAL 720 (H) x 540 (V) 720 (H) x 540 (V)
Dynamic Range	102 dB typical/120 dB maximum (DW/CW models only)
Scanning System	2:1 interlace (progressive option on CW/DW models only)
Synchronization	Internal
Electronic Shutter Range	Auto (1/15–1/22,000)
Lens Type	Varifocal with auto iris
Format Size	1/3-inch
Focal Length	3.0 mm–9.5 mm 9.0 mm–22.0 mm <list>
Operation	Iris Auto (DC-drive) Focus Manual Zoom Manual

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Minimum Illumination	Color (day): 0.8 lux, SENS 8X: 0.2 lux, B-W (night): 0.08 lux, SENS 8X: 0.02 lux (F1.0, 40 IRE, AGC on, 75% scene reflectance) Color (day): 0.15 lux, B-W (night): 0.015 lux (F1.0, 40 IRE, AGC on, 75% scene reflectance) Color (day): 0.8 lux, SENS 8X: 0.2 lux (F1.0, 40 IRE, AGC on, 75% scene reflectance) 0.2 lux (F1.0, 40 IRE, AGC on, 75% scene reflectance)															
Compression	MPEG-4, MJPEG in Web viewing mode															
Video Streams	3, simultaneous															
Video Resolutions	<table border="1"> <thead> <tr> <th></th> <th>NTSC</th> <th>PAL</th> </tr> </thead> <tbody> <tr> <td>4CIF</td> <td>704 x 480</td> <td>704 x 576</td> </tr> <tr> <td>2CIF</td> <td>704 x 240</td> <td>704 x 288</td> </tr> <tr> <td>CIF</td> <td>352 x 240</td> <td>352 x 288</td> </tr> <tr> <td>QCIF</td> <td>176 x 120</td> <td>176 x 144</td> </tr> </tbody> </table>		NTSC	PAL	4CIF	704 x 480	704 x 576	2CIF	704 x 240	704 x 288	CIF	352 x 240	352 x 288	QCIF	176 x 120	176 x 144
	NTSC	PAL														
4CIF	704 x 480	704 x 576														
2CIF	704 x 240	704 x 288														
CIF	352 x 240	352 x 288														
QCIF	176 x 120	176 x 144														
Bit Rate	Configurable, 20 kbps to 2 Mbps per stream															
Web User Interface																
Environment	Low temperature, indoor/outdoor															
Connectors	RJ-45 for 100BASE-TX, Auto MDI/MDI-X															
Cabling	CAT5 cable or better for 100BASE-TX															
Input Voltage	24 VAC (18-36) or PoE input voltage															
Power Consumption	<7.5 Watts, <13 Watts with heaters 24VAC: <0.5 Amps, <0.9 Amps with heaters															
Alarm Input	10 VDC maximum, 5 mA maximum															
Alarm Output	0 to 15 VDC maximum, 75 mA maximum															
Service Connector	Internal to housing for 2.5 mm connector for NTSC/PAL video outputs															
Service Connector	3-conductor, 2.5 mm connector for video output to optional (IS-SC cable)															
Pan/Tilt Adjustment	Pan 360°, tilt 80° (20° to 100° range), and rotation 360°															
Light Attenuation	smoked bubble, f/1.5 light loss; clear bubble, zero light loss															
CERTIFICATIONS	CE, Class B UL Listed Meets NEMA Type 4X and IP66 standards															

4. Accessories
  - a. Pendant mount
  - b. Wall mount for pendant
  - c. Corner adapter for wall mount
  - d. Pole adapter for wall mount

M. Megapixel High Definition Integrated Digital Network Camera

1. The network camera shall offer dual video streams with up to 3.1 megapixel resolution (2048 x 1536) in progressive scan format.

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2. An alarm input and relay output shall be built in for integration with hard wired external sensors.
3. The network camera shall be capable of firmware upgrades through a network using a software-based device utility.
4. The network camera shall offer auto back focus (ABF) functionality through a push button on the camera. ABF parameters shall also be configurable through a standard Web browser interface.
5. The network camera shall offer a video output port providing an NTSC/PAL analog video output signal for adjusting field of view and focus at the camera.
6. The network camera shall provide advanced low-light capabilities for color and day/night models with sensitivity down to 0.12 lux in color and 0.03 lux in black-white (B-W).
7. The network camera shall have removable IR cut filter mechanism for increased sensitivity in low-light installations. The sensitivity of IR cut filter removal shall be configurable through a Web browser.
8. The network camera shall support two simultaneous, configurable video streams. H.264 and MJPEG compression formats shall be available for primary and secondary streams with selectable unicast and multicast protocols. The streams shall be configurable in a variety of frame rates and bit rates.
9. The network camera shall support industry standard Power over Ethernet (PoE)
10. IEEE 802.3af to supply power to the camera over the network. The network camera shall also offer a 24 VAC power input for optional use.
11. The network camera shall use a standard Web browser interface for remote administration and configuration of camera parameters.
12. The network camera shall have a window blanking feature to conceal user-defined privacy areas that cannot be viewed by an operator. The network camera shall support up to four blanked windows. A blanked area shall appear on the screen as a solid gray window.
13. The network camera shall support standard IT protocols.
14. The network camera shall support open architecture best practices with a published API available to third-party network video recording and management systems.

N. Megapixel High Definition Integrated Digital Network Camera Technical Specifications:

Imaging Device	1/3-inch, effective
Imager Type	CMOS, Progressive scan
Maximum Resolution	2048 x 1536
Signal-to-Noise Ratio	50 dB
Auto Iris Lens Type	DC drive
Electronic Shutter Range	1~1/100,000 sec
Wide Dynamic Range	60 dB
White Balance Range	2,000° to 10,000°K
Sensitivity	f/1.2; 2,850K; SNR >24dB Color (1x/33ms) 0.50 lux Color SENS (15x/500 ms) 0.12 lux Mono SENS (15x/500 ms) Mono (1x/33ms)0.25 lux 0.03 lux
Dome Attenuation	Clear Zero light loss Smoke f/1.0 light loss
Compression	H.264 in base profile and MJPEG
Video Streams	Up to 2 simultaneous streams, the second Stream variable based on the setup of the primary stream
Frame Rate	Up to 30, 25, 24, 15, 12.5, 12, 10, 8, 7.5, 6.5, 4, 3, 2, and 1 (depending upon coding,

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	resolution, and stream configuration
Available Resolutions	<p>3.1 MPx2048 x 1536; 4:3 aspect ratio; 2.0 ips max., 10.0 Mbps bit rate for MJPEG; 3.0 ips max., 2.6 Mbps bit rate H.264</p> <p>2.1 MPx1920 x 1080; 16:9 aspect ratio: 15.0 ips max., 10.0 Mbps bit rate for MJPEG; 5.0 ips max., 2.7 Mbps bit rate H.264</p> <p>3.1.9 MPx1600 x 1200; 4:3 aspect ratio; 15.0 ips max., 10.0 Mbps bit rate for MJPEG; 6.0 ips max., 2.6 Mbps bit rate H.264</p> <p>1.3 MPx1280 x 1024; 5:4 aspect ratio; 15.0 ips max., 10.0 Mbps bit rate for MJPEG; 8.0 ips max., 2.5 Mbps bit rate H.264</p> <p>1.2 MPx1280 x 960; 4:3 aspect ratio; 15.0 ips max., 9.8 Mbps bit rate for MJPEG; 9.8 ips max., 8.5 Mbps bit rate H.264</p> <p>6.0.9 MPx1280 x 720; 16:9 aspect ratio; 30.0 ips max., 10.0 Mbps bit rate for MJPEG; 12.5 ips max., 2.5 Mbps bit rate H.264</p> <p>0.5 MPx800 x 600; 4:3 aspect ratio; 30.0 ips max., 5.8 Mbps bit rate for MJPEG; 25.0 ips max., 2.0 Mbps bit rate H.264</p> <p>8.0.3 MPx640 x 480; 4:3 aspect ratio; 30.0 ips max., 3.7 Mbps bit rate for MJPEG; 30.0 ips max., 1.6 Mbps bit rate H.264</p> <p>0.1 MPx320 x 240; 4:3 aspect ratio; 30.0 ips max., 0.9 Mbps bit rate for MJPEG; 30.0 ips max., 0.4 Mbps bit rate H.264</p> <p>Additional 640 x 512, 640 x 352, 480 x 368, 480 x 272, 320 x 256, 320 x 176</p>
Supported Protocols	TCP/IP, UDP/IP (Unicast, Multicast IGMP), UPnP, DNS, DHCP, RTP, RTSP, NTP, IPv4, SNMP, QoS, HTTP, HTTPS, LDAP(client), SSH, SSL, STMP, FTP, MDNS(Bonjour), and 802.1x (EAP)
Security Access	Password protected
Software Interface	Web browser view and setup, up to 16 cameras
Connectors	RJ-45 for 100Base-TX, Auto MDI/MDI-X
Cable	Cat5 cable or better for 100Base-TX
Input Voltage	24 VAC or PoE (IEEE802.3af class 3)
Power Consumption	6 W
Current Consumption	PoE <200 mA maximum 24 VAC <295 mA nominal; <390 mA maximum
Alarm Input	10 VDC maximum, 5 mA maximum
Alarm Output	0 to 15 VDC maximum, 75 mA maximum

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Lens Mount	CS mount, adjustable
Pan/Tilt Adjustment	Pan 368° Tilt 160° (10° to 170°) Rotate 355°

1. Accessories
  - a. Pendant mount
  - b. Wall mount for pendant
  - c. Corner adapter for wall mount
  - d. Pole adapter for wall mount
2. Recommended Lenses
  - a. Megapixel lens, varifocal, 2.2~6.0 mm, f/1.3~2.0
  - b. Megapixel lens, varifocal, 2.8~8.0 mm, f/1.1~1.9
  - c. Megapixel lens, varifocal, 2.8~12.0 mm, f/1.4~2.7
  - d. Megapixel lens, varifocal, 15.0~50.0 mm, f/1.5~2.1

O. NETWORK CAMERAS

1. Shall be IEEE 802.3af compliant.
  - a. Shall be utilized for interior and exterior purposes.
  - b. A Category CAT6 cable will be the primary source for carrying signals up to 100 m (300 ft. ) from a switch hub or network server. If any camera is installed greater than 100 m (300 ft. ) from the controlling device then the following will be required:
    - 1) A local or remote 12 VDC or 24 VAC power source will be required from a Class 2, UL compliant power supply.
    - 2) A signal converter will be required to convert from a CAT6 cable over to a fiber optic or standard signal cable. The signal will need to be converted back to a CAT6 cable at the controlling device using a signal converter card.
  - c. Shall be routed to a controlling device via a network switch.
  - d. Shall be of hybrid design with both an Internet Protocol (IP) output and a monitor video output which produces a picture equivalent to an analog camera, and allows simultaneous output of both.
  - e. Shall be a programmable IP address that allows for installation of multiple units in the same Local Area Network (LAN) environment.
  - f. Incorporate a minimum of Transmission Control Protocol (TCP)/IP, User Datagram Protocol (UDP), Hypertext Transfer Protocol (HTTP), File Transfer Protocol (FTP), Internet Control Message Protocol (ICMP), Address Resolution Protocol (ARP), Real-Time Transport Protocol (RTP), Dynamic Host Configuration Protocol (DHCP), Network Time Protocol (NTP), Simple Mail Transfer Protocol (SMTP), Internet Group Management Protocol (IGMP), and Differentiated Service Code Point (DSCP) protocols for various network applications.

P. Fixed Network Camera

1. The fixed network camera shall have following technical characteristics:

Video Standards	MPEG-4; M-JPEG
Video Data Rate	9.6 Kbps - 6 Mbps Constant & variable
Image Resolution	768x494 (NTSC)
Video Resolution	704 x 576/480 (4CIF: 25/30 IPS) 704 x 288/240 (2CIF: 25/30 IPS) 352 x 288/240 (CIF: 25/30 IPS) 176 x 144/120 (QCIF: 25/30 IPS)
Select Frame Rate	1-25/30 IPS (PAL/NTSC);Field/frame based coding
Network Protocols	RTP, Telnet, UDP, TCP, IP, HTTP, IGMP,

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	ICMP
Software Update	Flash ROM, remote programmable
Configuration	Via web browser, built-in web server interfaces
//Video Out	1x Analog composite: NTSC or PAL; BNC connector 75 Ohm//
Sensitivity	1 0.65 lux (color) 0.26 lux (NightSense)
Minimum Illumination	0.30 lux (color)0.12 lux (NightSense)
Video Signal-to-Noise Ratio	50 dB
Video Signal Gain	21 dB, (max) Electronic Shutter Automatic, up to 1/150000 sec. (NTSC)
Alarm In	Automatic sensing (2500 - 9000 K)
Input Voltage	+5 V nominal, +40 VDC max VDC: 11-36 V (700 mA) VAC: 12-28 V (700 mA) PoE: IEEE 802.3af compliant

2. Camera accessories shall include:
  - a. Surface mount adapter
  - b. Wall mount adapter
  - c. Flush mount adapter

Q. Wireless Cameras

1. Prior to installation of any wireless camera, ensure operating frequency is given full approval by the VA controlling authority. Wireless cameras shall be utilized as either part of a VASS network or a standard analog system.
2. Power for a wireless camera will be 110 VAC tied into a dedicated circuit breaker on a power panel that is dedicated to the security system and is fed from a power source with back-up in the event primary power to the VASS System is lost. Power will be run to the camera and connected at both ends in accordance with Division 26 of the VA Master Specification FOR NCA Projects, and the VA Electrical Manual. In addition, wireless systems are line of sight dependant and all considerations for environmental layout must be taken into consideration prior to design, engineering, and installation of this type of camera system. Proximity to transmitting and receiving devices, cell phone towers, and any and all electrical devices can also cause interference with the camera signal and must be considered in advance.
3. Shall be located within a minimum of one quarter of a mile from the receiving unit. Repeaters shall be used as required to ensure the strongest possible signal between transmitters and receivers.
4. Shall be Federal Communication Commission (FCC) approved and compliant.
5. If using wireless cameras, the following equipment shall be utilized to ensure operation of the system:
  - a. Receiver
  - b. Receiver antenna as required
  - c. Repeater as required
  - d. Mounting Hardware
6. Receivers shall only handle up to four (4) cameras per unit.
7. Technical Characteristics
  - a. Wireless Cameras:

Imaging Device	1/3-inch interline transfer CCD
Picture Elements	NTSC 510 (H) x 492 (V)
Sensing Area	6 mm diagonal



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Scanning System	NTSC 525 lines, 21 interlace
Synchronization System	AC line lock/internal
Horizontal Resolution	330 TV lines
Iris Control	Selectable on/off
Electronic Shutter Range NTSC	1/60-1/100,000 second
Frequency range	2.41-2.47GHz
Modulation	FM
Video signal/noise ratio	48dB
Audio signal/noise ratio	45db
Minimum Illumination	0.6 lux
Signal to Noise Ratio	>50 dB
Automatic Gain Control	On/off switchable
Backlight Compensation	On/off switchable
Auto White Balance	On/off switchable
Video Output	1 Vp-p, 75 ohms
Lens Mount	C/CS mount (adjustable)

1) Receivers	
Frequency range	2.4-2.49GHz
Video output	1Vp-p
Signal/noise ratio	38dB

R. LENSES

1. Camera Field of View shall be set by the Contractor to produce full view of door or window opening and anyone entering or leaving through it. Follow the project construction drawings for design intent.
2. Camera Lenses shall be of the type supplied with the camera from the manufacture. All cameras which are not supplied with lenses from the factory are specified in this specification. The lens shall be equipped with an auto-iris mechanism unless otherwise specified. Lenses having auto-iris, DC iris, or motor zoom functions shall be supplied with connectors, wiring, receiver/drivers, and controls as needed to operate the lens functions. Lenses shall have sufficient circle of illumination to cover the image sensor evenly. Lenses shall not be used on a camera with an image format larger than the lens is designed to cover. Lenses shall be provided with pre-set capability.
3. Lenses shall have optical-quality coated optics, designed specifically for video surveillance applications, and matched to specified camera. Provide color-corrected lenses with color cameras, megapixel lenses for megapixel cameras, and lenses with day/night for color/b&w cameras.
4. Auto-Iris Lens: Electrically controlled iris with circuit set to maintain a constant video level in varying lighting conditions.
5. Zoom Lenses: Motorized, remote-controlled units, rated as "quiet operating." Features include the following:
  - a. Electrical Leads: Filtered to minimize video signal interference.
  - b. Motor Speed: Variable.
  - c. Lens shall be available with preset positioning capability to recall the position of specific scenes.
6. Lenses: Shall be utilized in a manner that provides maximum coverage of the area being monitored by the camera. The lenses shall:
  - a. Be 1/3-inch to fit CCD fixed camera.
  - b. Be all glass with coated optics.
  - c. Have mounts that are compatible with the camera selected.

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- d. Be packaged and supplied with the camera.
- e. Have a maximum f-stop of f/1.3 for fixed lenses, and a maximum f-stop of f/1.6 for variable focus lenses.
- f. Be equipped with an auto-iris mechanism.
- g. Have sufficient circle of illumination to cover the image sensor evenly.
- h. Not be used on a camera with an image format larger than the lens is designed to cover.
- i. Be provided with pre-set capability.
- 7. Two types of lenses shall be utilized for both interior and exterior fixed cameras:
  - a. Manual Variable Focus
  - b. Auto Iris Fixed
- 8. Manual Variable Focus:
  - a. Shall be utilized in large areas that are being monitored by the camera. Examples of this are perimeter fence lines, vehicle entry points, parking areas, etc.
  - b. Shall allow for setting virtually any angle of field, which maximizes surveillance effects.
  - c. Technical Characteristics:

Image format	1/3 inch
Focal length	5–50mm
Iris range	F1.4 to close
Focus range	1m (3.3 ft)
Back focus distance	10.05 mm (0.4 in)
Angle view Wide (1/3 in)	53.4 x 40.1
Angle view Tele (1/3 in)	5.3 x 4.1
Iris control	manual
Focus ctrl	manual
Zoom ctrl	manual

S. CAMERA HOUSINGS AND MOUNTS

- 1. This section pertains to all interior and exterior housings, domes, and applicable wall, ceiling, corner, pole, and rooftop mounts associated with the housing. Housings and mounts shall be specified in accordance to the type of cameras used.
- 2. All cameras and lenses shall be enclosed in a tamper resistant housing. Any additional mounting hardware required to install the camera housing at its specified location shall be provided along with the housing.
- 3. The camera and lens contained inside the housing shall be installed on a camera mount. All additional mounting hardware required to install the camera housing at its specified location shall be provided along with the housing.
- 4. Shall be manufactured in a manner that are capable of supporting a maximum of three (3) cameras with housings, and meet environmental requirements for the geographical area the camera support equipment is being installed on or within.
- 5. Environmentally Sealed
  - a. Shall be designed in manner that it provides a condensation free environment for correct camera operation.
  - b. Shall be operated in a 100 percent condensing humidity atmosphere.
  - c. Shall be constructed in a manner that:
    - 1) Has a fill valve to allow for the introduction of nitrogen into the housing to eliminate existing atmospheric air and pressurize the housing to create moisture free conditions.
    - 2) Has an overpressure valve to prevent damage to the housing in the event of over pressurization.

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- 3) Is equipped with a humidity indicator that is visible to the eye to ensure correct atmospheric conditions at all times.
  - 4) The leak rate of the housing is not to be greater than 13.8kPa or 2 pounds per square inch at sea level within a 90 day period.
  - 5) It shall contain camera mounts or supports as needed to allow for correct positioning of the camera and lens.
  - 6) The housing and sunshield are to be white in color.
6. All electrical and signal cables required for correct operations shall be supplied in a hardened carrier system from the controller to the camera.
  7. The mounting bracket shall be adjustable to allow for the housing weight of the camera and the housing unit it is placed in.
  8. Accessibility to the camera and mounts shall be taken into consideration for maintenance and service purposes.
- T. Indoor Mounts
1. Ceiling Mounts:
    - a. This enclosure and mount shall be installed in a finished or suspended ceiling.
    - b. The enclosure and mount shall be fastened to the finished ceiling, and shall not depend on the ceiling tile grid for complete support.
    - c. Suspended ceiling mounts shall be low profile, and shall be suitable for replacement of 610mm x 610mm (2 foot by 2 foot) ceiling tiles.
  2. Wall Mounts:
    - a. The enclosure shall be installed in manner that it matches the existing décor and placed at a height that it will be unobtrusive, unable to cause personal harm, and prevents tampering and vandalism.
    - b. The mount shall contain a manual pan/tilt head that will provide 360 degrees of horizontal and vertical positioning from a horizontal position, and has a locking bar or screw to maintain its fixed position once it has been adjusted.
- U. Interior Domes
1. The interior dome shall be a pendant mount, pole mount, ceiling mount, surface mount, or corner mounted equipment.
  2. The lower portion of the dome that provides camera viewing shall be made of black opaque acrylic and shall have a light attenuation factor of no more that 1 f-stop.
  3. The housing shall be equipped with integral pan/tilt capabilities complete with wiring, wiring harness, connectors, receiver/driver, pan/tilt control system, pre-position cards, or any other hardware and equipment as needed to fully provide a fully functional pan/tilt dome.
  4. The pan/tilt mechanism shall be:
    - a. Constructed of heavy duty bearings and hardened steel gears.
    - b. Permanently lubricated to ensure smooth and consistent movement of all parts throughout the life of the product.
    - c. Equipped with motors that are thermally or impedance protected against overload damage.
    - d. Pan movements shall be 360 degrees and tilt movement shall no be less than +/- 90 degrees.
    - e. Pan speed shall be a minimum of 10 degrees per second.
- V. Exterior Domes
1. The exterior dome shall meet all requirements outlined in the interior dome paragraph above.
  2. The housing shall be constructed to be dust and water tight, and fully operational in 100 percent condensing humidity.
- W. Exterior Wall Mounts
1. Shall have an adjustable head for mounting the camera.

2. Shall be constructed of aluminum, stainless steel, or steel with a corrosion-resistant finish.
  3. The head shall be adjustable for not less than plus and minus 90 degrees of pan, and not less than plus and minus 45 degrees of tilt. If the bracket is to be used in conjunction with a pan/tilt, the bracket shall be supplied without the adjustable mounting head, and shall have a bolt-hole pattern to match the pan/tilt base.
  4. Shall be installed at a height that allows for maximum coverage of the area being monitored.
- X. Explosion Proof Housing
1. This housing shall meet or exceed all requirements of NEMA four (4) standards for hazardous locations.
  2. It shall be supplied with the mounting brackets for the specified camera and lens.

## 2.08 POWER SUPPLIES

- A. Power supplies shall be a low-voltage power supplies matched for voltage and current requirements of cameras and accessories, type as recommended by camera[, infrared illuminator,] and lens manufacturer.
- B. Technical specifications:
1. Input: 115VAC, 50/60Hz, 2.7 amps
  2. Outputs:
    - a. Number of outputs, [16]
    - b. [Fuse/PTC] protected, power limited
    - c. Output voltage & power:
      - 1) 24VAC @ 12.5 amps (300VA) or 28VAC @ 10 amp (280VA) supply current
  3. Illuminated power disconnect circuit breaker with manual reset
  4. Surge suppression
  5. Camera synchronization
  6. [Wall/Rack] mount.
  7. Enclosure: NEMA 250, Type [1] [3] [4X] .

## 2.09 INFRARED ILLUMINATORS

- A. Lighting fixtures that emit light only in the infrared spectrum, suitable for use with cameras indicated, for nighttime surveillance, without emitting visible light.
1. Field-Selectable Beam Patterns: Narrow, medium, and wide.
  2. Rated Lamp Life: More than 8000 hours
  3. Power Supply: [12-VAC/DC] [120-VAC].
- B. Area Coverage: Illumination to 50 m (150 feet) in a narrow beam pattern.
- C. Exterior housings shall be suitable for same environmental conditions as associated camera.

## 2.10 NETWORK SERVER

- A. Allow for the transmission of live video, data, and audio over either an existing Ethernet network or a dedicated security system network, requiring an IP address or Internet Explorer 5.5 or higher, or shall work as an analog-to-Ethernet "bridge" controlling matrices, multiplexers, and pan/tilt/zoom cameras. The network shall operate in a box-to-box configuration allowing for encoded video to be decoded and displayed on an analog monitor.
- B. If a VASS System network is going to be utilized as the primary means of monitoring, operating, and recording cameras then the following equipment shall be required as part of the system:
1. System Server
  2. Computer Workstation
  3. Recording Device
  4. Encoder/Decoder
  5. Monitor
  6. Hub/Switch

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- 7. Router
- 8. Encryptor
- C. Shall provide overall control, programming, monitoring, and recording of all cameras and associated devices within the VASS System.
- D. All equipment on the network shall be IP addressable.
- E. The VASS System network shall meet or exceed the following design and performance specifications:
  - 1. Two MPEG-4 video streams for a total of 40 images per second will be provided.
  - 2. PC Software that manages the installation and maintenance of all hardware transmitters and receivers on the network shall be provided.
  - 3. Video Source that supports any NTSC video source to the computer network shall be addressed.
  - 4. Receivers that could be used to display the video on a standard analog NTSC or PAL monitor will be addressed.
- F. The system shall support the following network protocols:
  - 1. Internet connections: RTP, Real Time Control Protocol (RTCP), UDP, IP, TCP, ICMP, HTTP, Simple Network Management Protocol (SNMP), IGMP, DHCP, and ARP.
  - 2. Video Display: MPEG-4, M-JPEG in server push mode only.
  - 3. Have the ability to adjust bandwidth, image quality and image rate.
  - 4. Support image sizes of either 704 x 576 pixels or 352 x 288 pixels.
  - 5. Have an audio coding format of G.711 or G.728.
  - 6. Provide a video frame rate of at least 30 images per second.
  - 7. Support LAN Interface Ethernet 10/100BaseT and be auto sensing.
  - 8. Have a LAN Data Rate of 9.6 Kbps to 5.0 Mbps.
  - 9. Utilize data interface RS-232/RS-422/RS-485.
- G. All connections within the system shall be via CAT-5 cable and RJ-45 jacks. If analog equipment is used as part of the system, then either an encoder or a decoder will be utilized to convert the analog signal to a digital one.
- H. The VASS network system shall conform to all VA agency wide security standards for administrator and operator use.

I. Server Technical Characteristics:

Hardware	Personal Computer
CPU	Pentium IV, 3.0 GHz or better
Hard Disk Interface	IDE or better
RAM	256 MB
OS	Windows XP Home/XP Professional
Graphic Card	NVIDIA GeForce 6600          NVIDIA Quadro FX 1400      ATI RADEON X600/X800 or better
Ethernet Card	100 Mb
Software	DirectX 9.0c
Free Memory	120 MB

J. Network Switch Technical Characteristics

Protocol and standard	IEEE802.3 IEEE802.3u IEEE802.3ab
Ports	24 10/100/1000M auto-negotiation RJ-45 ports with auto MDI/MDI-X

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Network media	Cat 5 UTP for 1,000Mbps Cat 3 UTP for 10Mbps
Transmission method	store-and-forward
LED	indicator power, act/link, speed

K. Router Technical Characteristics

Network Standards	IEEE 802.3, 802.3u 10Base-T Ethernet (WAN) 100Base-T Ethernet (LAN) IEEE 802.3x Flow Control IEEE802.1p Priority Queue ANS/IEEE 802.3 NWay auto-negotiation
Protocol	CSMA/CD, TCP, IP, UDP, PPPoE, AND DHCP (client and server)
VPN Supported	PPTP, IPSec pass-through
Management	Browser
Ports	4 x 10/100Base-T Auto sensing RJ45 ports, and an auto uplink RJ45port(s) 1 x 10Base-T RJ45 port, WAN
LEDs	Power, WAN Activity, LAN Link (10/100), LAN Activity

L. Encryptor Technical Characteristics:

Cryptography	Standard - Triple DES 168-bit (ANSI 9.52) Rijndael - AES (128, 192, 256)
Performance	Throughput (end-to-end) @ 100 Mbps line speed: >188 Mbps full duplex (large frames) >200 kfps full duplex (small frames) Latency (end-to-end) @ 100 Mbps
Key Management	Automatic KEK/DEK Exchange Using Signed Diffie-Hellman Unit Authentication Using X.509 Certificates
Physical Interfaces	10BaseT or 10/100BaseT Ethernet (Host and Network Ports) 10BaseT Ethernet Management Port Back and Front-Panel Serial Control Port
Device Management	THALES Element Manager, Front Panel Viewer, and Certificate Manager 10Base T (RJ-45) or 9-pin Serial Control Port SNMP Network Monitoring
Security Features	Tamper Proof Cryptographic Envelope Tamper Evident Chassis Hardware Random Number Generator
Management	Channel Encrypted Using Same Algorithm as Data Traffic
Security Certifications	FIPS 140-2 Level 3 CAPS Baseline and Enhanced Grades Common Criteria EAL4 and EAL5 (under evaluation)
Regulatory	EN60950, FCC, UL, CE, EN 50082-1, and EN

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- M. Recording devices
- N. All cameras on the VASS System shall be recorded in real time using a Digital Video Recorder (DVR), Network Video Recorder (NVR), or attached storage. The type of recording device utilized should be determined by the size and type of VASS System designed and installed, and to what extent the system is to be utilized.
- O. All recording devices shall be 47.5 cm (19 inch) rack-mountable.
- P. All DVR's and NVR's that are viewable over an Intranet or Internet will be routed through an encryptor.
- Q. Encryptors shall:
  - 1. Comply with FIPS PUB 140-2.
  - 2. Support TCP/IP.
  - 3. Directly interfaces to low-cost commercial routers.
  - 4. Provide packet-based crypto synchronization.
  - 5. Encrypt source and destination IP addresses.
  - 6. Support web browser based management requiring no additional software.
  - 7. Have a high data sustained throughput — 1.544 Mbps (T1) full duplex data rate.
  - 8. Provide for both bridging and routing network architecture support.
  - 9. Support Electronic Key Management System (EKMS) compatible.
  - 10. Have remote management ability.
  - 11. Automatically reconfigure when secure network or wide area network changes.
- R. Digital Video Recorder (DVR)
  - 1. Shall record video to a hard drive-based digital storage medium in either NTSC or MPEG format.
  - 2. Shall meet the following minimum requirements:
    - a. Record at minimum rate of 30 images per second (IPS).
    - b. Have a minimum of eight (8) to 16 looping inputs.
    - c. Have a minimum of eight (8) to 16 alarm inputs and two (2) relay outputs.
    - d. Shall provide instantaneous playback of all recorded images.
    - e. Be IP addressable, if part of a VASS network.
    - f. Have built-in digital motion detection with masking and sensitivity adjustments.
    - g. Provide easy playback and forward/reverse search capabilities.
    - h. Complete audit trail database, with minimum of a six-month history that tracks all events related to the alarm; specifically who, what, where and when.
    - i. DVR management capability providing automatic video routing to a back-up spare recorder in case of failure.
    - j. Accessible locally and remotely via the Internet, Intranet, or a personal digital assistant (PDA).
    - k. Records all alarm events in real time, ensuring 60 seconds before and after the event are included in the recording.
    - l. Utilize RS-232 or fiber optic connections for integration with the SMS computer station via a remote port on a network hub.
    - m. Allow for independently adjustable frame rate settings.
    - n. Be compatible with the matrix switcher utilized to operate the cameras. The DVR could be utilized as a matrix switcher only if it meets all of the requirements listed in the matrix switcher section.
  - 3. Technical Characteristics:

Compression	MPEG-4
Internal Storage Capacities.	[160] GB, [320] GB, [500] GB, [1] TB, and 2 TB. Available USB hard drive up to 250 GB.

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	Optional internal DVD available
Digital Recording	Up to [16] video and [8] audio channels, or [8] video and [4] audio channels.
Full real-time video recording	Up to 400 IPS@352 x 288: PAL Up to 200 IPS@352 x 288: PAL
Multiple simultaneous functions	Live viewing, Recording, playback, network transmission, back-up
Search functions	Date/time search, event search, bookmark search, smart (pixel) Search
PTZ Control	Third party PTZ control
User ID security	3 levels
Connectivity to external devices:	Eight [8] or sixteen [16] video input and looping output channels. VGA and dual monitor BNC outputs. Four [4] or eight [8] audio inputs and one [1] audio output. Ethernet 10/100BaseT network connection. Eight [8] to sixteen [16] alarm inputs and four [4] or eight [8] relay outputs. Biphase connection to control Bosch PTZ cameras. Third party PTZ control via RS-422/RS-485 connection. Front and back USB connectors to connect to a PC mouse, or archive video to a USB memory stick or similar device.
PC requirements	Windows 2000 or above; DirectX 8.1 or above. Intel Pentium III or above, AMD Athlon with 800 MHz or faster CPU. 512 MB or more RAM. 50 MB hard drive. AGP VGA with 64 MB video RAM or above. 10/100-BaseT network interface.
Electrical	Power Input: 100 to 240 VAC; 50/60 Hz Power consumption: [120W] Max. [1.2] A
Video	Video standard: PAL or NTSC selectable. Resolution: 704 x 576 PAL, 704 x 480 NTSC Compression: MPEG-4 Inputs: 8 or 16 composite video 0.5-2 Vpp, 75 Ohm automatic termination. Outputs 8 or 16 composite video 1 Vpp, 75 Ohm.
Audio	Inputs: 4 or 8 line in, 30 kOhm Output: 1 line, 100 kOhm
Monitors	VGA: analog RGB 800x600



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	MON A: CVBS 1 Vpp□0.1 V, 75 Ohm, BNC Monitor A multi-screen (VGA or CVBS) MON B: CVBS 1 Vpp□0.1 V, 75 Ohm, BNC Monitor B spot/alarm
Frame Rate and Resolution	[16]-channels PAL: Up to 400 IPS@352x288, up to 200 IPS@704x288, up to 100 IPS@704x576.
Alarm inputs	[8] [16] configurable NO/NC, max. input 5 VDC.
Alarm outputs	[4] or [8] relay outputs, configurable NO/NC, max. rated 1A, 125 VAC.
Connections	Ethernet: RJ45 modular jack 8 pins shielded, 10/100 Base-T. Biphase: Screw terminal connector (5 outputs). Maximum 5 controllable cameras per Biphase output. PTZ control interfaces: RS485/RS422. Serial interface: RS232 output signal, DB9 male connector Keyboard: RJ11 modular jack 6 pins
Network:	Transmission speed: up to 120 IPS@352x240 Bandwidth control: Automatic Remote users: Maximum 5 simultaneous connected Control Center users.
Processor	Intel Pentium III 750 MHz
Memory	256 MB RAM
Operating System	Windows 98, NT, ME, 2000, and XP
Video Card	4 MB of RAM capable of 24-bit true color display
Free Hard Disk Space	160 MB for software installation
Network Card	10Base-T network for LAN operation
Archiving	80 GB, 160 GB, 320 GB and 640 GB Hard Drive; CD-RW
Video Input	1.0 Vpp (signal 714mV, sync 286mV) 75 ohms (BNC unbalanced)
Video Output Level	1.0 Vpp +/-10%,75 ohms(BNC unbalanced)
Impedance	75 ohms/Hi- impedance x 16 switchable
Network Interface	Ethernet (RJ-45, 10/100M)
Network Protocol	TCP/IP, DHCP, HTTP, UDP
Network Capabilities	Live/Playback/P/T/Z control
Recording Rate	30 ips for 720 x 240 (NTSC)
Password Protection	Menu Setup, Remote Access
Recording Capacity	160 (1 or 2 fixed HDD) 1 CD-RW
Power Interrupt	Auto recovered to recording mode

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S. Network Video Recorder (NVR)

1. Shall record video to a hard drive-based digital storage medium in MPEG, MPEG4 or H.264 format.
2. Shall meet the following minimum requirements:
  - a. Record at minimum rate of 30 IPS.
  - b. Have a minimum of eight (8) to 16 looping inputs.
  - c. Have a minimum of eight (8) to 16 alarm inputs and two (2) relay outputs.
  - d. Shall provide instantaneous playback of all recorded images.
  - e. Be IP addressable, if part of a VASS network.
  - f. Have built-in digital motion detection with masking and sensitivity adjustments.
  - g. Easy playback and forward/reverse search capabilities.
  - h. Complete audit trail database, with minimum of a six-month history that tracks all events related to the alarm; specifically who, what, where and when.
  - i. NVR management capability providing automatic video routing to a back-up spare recorder in case of failure.
  - j. Accessible locally and remotely via the internet, intranet, or a personal digital assistant (PDA).
  - k. Records all alarm events in real time, ensuring 60 seconds before and after the event are included in the recording.
  - l. Utilize RS-232 or fiber optic connections for integration with the SMS computer station via a remote port on a network hub.
  - m. Allow for independently adjustable frame rate settings.
  - n. Be compatible with the matrix switcher utilized to operate the cameras.
3. Technical Characteristics:

Hardware/CPU	Pentium III Xeon or IV, 1.8 GHz
HDD Interface	IDE or better; optional: SCSI II, SCSI Ultra, or Fiber Channel
RAM	1024 MB
Operating System	Windows 2000/XP Professional/Server 2003 Standard
Graphic	Card VGA
Ethernet Card	100/1000 MB
Memory	20 MB
Software Setup	Centralized setup from each authorized PC; access via integrated web server
Storage Media	All storage media possible (e.g., HD, RAID), depending on operating system
Storage Mode	Linear mode, ring mode (capacity-based)
Recording Configuration	Camera name assignment, bandwidth limit, frame rate, video quality
Recording Content	Video and/or audio data
Search Parameters	Time, date, event
Playback	Playback via any IP network (LAN/WAN) simultaneous recording, playback, and backup
Network Interface	Ethernet (RJ-45, 10/100M)
Network Protocol	TCP/IP, DHCP, HTTP, UDP
Network Capabilities	Live/Playback/P/T/Z control

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Recording Rate	30 ips for 720 x 240 (NTSC)
Password Protection	Menu Setup, Remote Access
Recording Capacity	160 (1 or 2 fixed HDD) 1 CD-RW
Power Interrupt	Auto recovered to recording mode

**2.11 WIRES AND CABLES**

- A. Shall meet or exceed the manufactures recommendation for power and signal.
- B. Will be carried in an enclosed conduit system, utilizing electromagnetic tubing (EMT) to include the equivalent in flexible metal, rigid galvanized steel (RGS) to include the equivalent of liquid tight, polyvinylchloride (PVC) schedule 40 or 80.
- C. All conduits will be sized and installed per the NEC. All security system signal and power cables that traverse or originate in a high security office space will contained in either EMT or RGS conduit.
- D. All conduit, pull boxes, and junction boxes shall be clearly marked with colored permanent tape or paint that will allow it to be distinguished from all other conduit and infrastructure.
- E. Conduit fills shall not exceed 50 percent unless otherwise documented.
- F. A pull string shall be pulled along and provided with signal and power cables to assist in future installations.
- G. At all locations where there is a wall penetration or core drilling is conducted to allow for conduit to be installed, fire stopping materials shall be applied to that area
- H. High voltage and signal cables shall not share the same conduit and shall be kept separate up to the point of connection. High voltage for the security system shall be defined as any cable or sets of cables carrying 30 VDC/VAC or higher.
- I. For all equipment that is carrying digital data between the Physical Access Control System and Database Management or at a remote monitoring station, shall not be less that 20 AWG and stranded copper wire for each conductor. The cable or each individual conductor within the cable shall have a shield that provides 100% coverage. Cables with a single overall shield shall have a tinned copper shield drain wire.
- J. All cables and conductors, except fiber optic cables, that act as a control, communication, or signal lines shall include surge protection. Surge protection shall be furnished at the equipment end and additional triple electrode gas surge protectors rated for the application on each wire line circuit shall be installed within 1 m. (3 ft.) of the building cable entrance. The inputs and outputs shall be tested in both normal and common mode using the following wave forms:
  - 1. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 watts and peak current of 60 amperes.
  - 2. An 8 microsecond rise time by 20 microsecond pulse width wave form with a peak voltage of 1000 volts and peak current of 500 amperes.
- K. The surge suppression device shall not attenuate or reduce the video or sync signal under normal conditions. Fuses and relays shall not be used as a means of surge protection.
- L. Coaxial Cables
  - 1. All video signal cables for the VASS System, with exception to the PoE cameras, shall be a coaxial cable and have a characteristic impedance of 75 ohms plus or minus 3 ohms.
  - 2. For runs up to 750 feet use of an RG-59/U is required. The RG-59/U shall be shielded which provides a minimum of 95 percent coverage, with a stranded copper center conductor of a minimum 23 AWG, polyethylene insulation, and black non-conductive polyvinylchloride (PVC) jacket.
  - 3. For runs between 750 feet and 1250 feet, RG-6/U is required. RG-6/U shall be shielded which provides a minimum of 95 percent coverage, with a stranded copper center conductor of a minimum 18 AWG, polyethylene insulation, and black non-conductive polyvinylchloride (PVC) jacket.

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4. For runs of 1250 to 2750 feet, RG-11/U is required. RG-11/U shall be shielded which provides a minimum of 95 percent coverage, with a stranded copper center conductor of a minimum 14 AWG, polyethylene insulation, and black non-conductive polyvinylchloride (PVC) jacket.
5. All runs greater than 2750 feet will be substituted with a fiber optic cable. If using fiber optics as a signal carrier then the following equipment will be utilized:
  - a. Multimode fiber optic cable a minimum size of 62 microns
  - b. Video transmitter, installed at the camera that utilizes 12 VDC or 24 VAC for power.
  - c. Video receiver, installed at the switcher.

6. RG-59/U Technical Characteristics

AWG	22
Stranding	7x29
Conductor Diameter	.031 in.
Conductor Material	BCC
Insulation Material	Gas-injected FHDPE
Insulation Diameter	.145 in.
Outer Shield Type	Braid/Braid
Outer Jacket Material	PVC
Overall Nominal Diameter	.242 in.
UL Temperature Rating	75°C
Nom. Characteristic Impedance	75 Ohms
Nom. Inductance	0.094 µH/ft
Nom. Capacitance	Conductor to Shield 17.0 pF/ft
Nom. Velocity of Propagation	80 %
Nom. Delay	1.3 ns/ft
Nom. Conductor DC Resistance @ 20°C	12.2 Ohms/1000 ft
Nom. Outer Shield DC Resistance @ 20°C	2.4 Ohms/1000 ft
Max. Operating Voltage	UL 300 V RMS

7. RG-6/U Technical Characteristics:

AWG	18
Stranding	7x27
Conductor Diameter	.040 in.
Conductor Material	BC
Insulation Material	Gas-injected FHDPE
Insulation Diameter	.180 in.
Outer Shield Material	Trade Name Duofoil
Outer Shield Type	Tape/Braid
Outer Shield %Coverage	100 %
Outer Jacket Material	PVC
Overall Nominal Diameter	.274 in.
Nom. Characteristic Impedance	75 Ohms
Nom. Inductance	0.106 µH/ft
Nom. Capacitance	Conductor to Shield 16.2 pF/ft
Nom. Velocity of Propagation	82 %
Nom. Delay	1.24 ns/ft

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Nom. Conductor DC Resistance	6.4 Ohms/1000 ft
Nominal Outer Shield DC Resistance @ 20°C	2.8 Ohms/1000 ft
Max. Operating Voltage	UL 300 V RMS

8. RG-11/U Technical Characteristics:

AWG	15
Stranding	19x27
Conductor Diameter	.064 in.
Conductor Material	BC
Insulation Material	Gas-injected FHDPE
Insulation Diameter	.312 in.
Inner Shield Type	Braid
Inner Shield Material	BC - Bare Copper
Inner Shield %Coverage	95 %
Inner Jacket Material	PE – Polyethylene
Inner Jacket Diameter	.391 in.
Outer Shield Type	Braid
Outer Shield Material	BC - Bare Copper
Outer Shield %Coverage	95 %
Outer Jacket Material	Trade Name Belflex
Outer Jacket Material	PVC Blend
Overall Nominal Diameter	.520 in.
Operating Temperature Range	-35°C To +75°C
Non-UL Temperature Rating	75°C
Nom. Characteristic Impedance	75 Ohms
Nom. Inductance	0.097 µH/ft
Nom. Capacitance	Conductor to Shield 17.3 pF/ft
Nom. Velocity of Propagation	78 %
Nom. Delay	1.30 ns/ft
Nom. Conductor DC Resistance	3.1 Ohms/1000 ft
Nom. Inner Shield DC Resistance	1.8 Ohms/1000 ft
Nom. Outer Shield DC Resistance	1.4 Ohms/1000 ft
Max. Operating Voltage Non-UL	300 V RMS

9. Signal Cables:

- a. Signal wiring for PoE cameras depends on the distance the camera is being installed from either a hub or the server.
- b. If the camera is up to 300 ft from a hub or the server, then use a shielded UTP category 5 (CAT-V) cable with standard RJ-45 connector at each end. The cable must comply with the Power over Ethernet, IEEE802.3af, Standard.
- c. If the camera is over 300 ft from a hub or server then utilize a multimode fiber optic cable with a minimum size of 62 microns.
- d. Provide a separate cable for power.
- e. CAT-5 Technical Characteristics:

Number of Pairs	4
Total Number of Conductors	8
AWG	24

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Stranding	Solid
Conductor Material	BC - Bare Copper
Insulation Material	PO – Polyolefin
Overall Nominal Diameter	.230 in.
IEC Specification	11801 Category 5
TIA/EIA Specification	568-B.2 Category 5e
Max. Capacitance Unbalance	(pF/100 m) 150 pF/100 m
Nom. Velocity of Propagation	70 %
Max. Delay	(ns/100 m) 538 @ 100MHz
Max. Delay Skew	(ns/100m) 45 ns/100 m
Max. Conductor DC Resistance	9.38 Ohms/100
Max. DCR Unbalance@ 20°C	3 %
Max. Operating Voltage	UL 300 V RMS

f. Fiber Optic Cables Technical Characteristics:

Fiber Type	62.5 Micron
Number of Fibers	4
Core Diameter 6	2.5 +/- 2.5 microns
Core Non-Circularity	5% Maximum
Clad Diameter	125 +/- 2 microns
Clad Non-Circularity	1% Maximum
Core-clad Offset	1.5 Microns Maximum
Primary Coating Material	Acrylate
Primary Coating Diameter	245 +/- 10 microns
Secondary Coating Material	Engineering Thermoplastic
Secondary Coating Diameter	900 +/- 50 microns
Strength Member Material	Aramid Yarn
Outer Jacket Material	PVC
Outer Jacket Color	Orange
Overall Diameter	.200 in.
Numerical Aperture	.275
Maximum Gigabit Ethernet	300 meters
Maximum Gigabit Ethernet	550 meters

10. Power Cables

- a. Will be sized accordingly and shall comply with the NEC. High voltage power cables will be a minimum of three conductors, 14 AWG, stranded, and coated with a non-conductive polyvinylchloride (PVC) jacket. Low voltage cables will be a minimum of 18 AWG, stranded and non-conductive polyvinylchloride (PVC) jacket.
- b. Will be utilized for all components of the VASS System that require either a 110 VAC 60 Hz or 220 VAC 50 Hz input. Each feed will be connected to a dedicated circuit breaker at a power panel that is primarily for the security system.
- c. All equipment connected to AC power shall be protected from surges. Equipment protection shall withstand surge test waveforms described in IEEE C62.41. Fuses shall not be used as a means of surge protection.
- d. Shall be rated for either 110 or 220 VAC, 50 or 60 Hz, and shall comply with VA Master Spec 26 05 21 Low Voltage Electrical Power Conductors and Cables (600 Volts and Below).
- e. Low Voltage Power Cables

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- 1) Shall be a minimum of 18 AWG, Stranded and have a polyvinylchloride outer jacket.
- 2) Cable size shall determined using a basic voltage over distance calculation and shall comply with the NEC's requirements for low voltage cables.

### **PART 3 - EXECUTION**

#### **3.01 . GENERAL**

- A. Installation: The Contractor shall install all system components including Owner furnished equipment, and appurtenances in accordance with the manufacturer's instructions, ANSI C2 and as shown, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable data transmission system.
- B. Identification and Labeling: The Contractor shall supply permanent identification labels for each cable at each end that will appear on the as-built drawings. The labeling format shall be identified and a complete record shall be provided to the Owner with the final documentation. Each cable shall be identified by type or signal being carried and termination points. The labels shall be printed on letter size label sheets that are self laminated vinyl that can be printed from a computer data base or spread sheet. The labels shall be E-Z code WES12112 or equivalent.
  1. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing.
- C. Transient Voltage Surge Suppressors (TVSS): The Contractor shall mount TVSS within 3 m (118 in) of equipment to be protected inside terminal cabinets or suitable NEMA 1 enclosures. Terminate off-premise conductors on input side of device. Connect the output side of the device to the equipment to be protected. Connect ground lug to a low impedance earth ground (less than 10 ohms) via Number 12 AWG insulated, stranded copper conductor.
- D. Contractor's Field Test: The Contractor shall verify the complete operation of the data transmission system during the Contractor's Field Testing. Field test shall include a bit error rate test. The Contractor shall perform the test by sending a minimum of 1,000,000 bits of data on each DTM circuit and measuring the bit error rate. The bit error rate shall not be greater than one (1) bit out of each 100,000 bits sent for each dial-up DTM circuit, and one (1) bit out of 1,000,000 bits sent for each leased or private DTM circuit. The Contractor shall submit a report containing results of the field test.
- E. Acceptance Test and Endurance Test: The wire line data transmission system shall be tested as a part of the completed IDS and EECS during the Acceptance test and Endurance Test as specified.
- F. Identification and Labeling: The Contractor shall supply identification tags or labels for each cable. Cable shall be labeled at both end points and at intermediate hand holes, manholes, and junction boxes. The labeling format shall be identified and a complete record shall be provided to the Owner with the final documentation. Each cable shall be identified with type of signal being carried and termination points.

#### **3.02 INSTALLATION**

- A. System installation shall be in accordance with NECA 303, manufacturer and related documents and references, for each type of security subsystem designed, engineered and installed.
- B. Components shall be configured with appropriate "service points" to pinpoint system trouble in less than 30 minutes.
- C. The Contractor shall install all system components including Government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, documentation listed in Sections 1.5 of this document, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable system.

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- D. The VASS System will be designed, engineered, installed, and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the system is a stand alone or a complete network.
- E. For integration purposes, the VASS System shall be integrated where appropriate with the following associated security subsystems:
  - 1. PACS:
    - a. Provide 24 hour coverage of all entry points to the perimeter and agency buildings, as well as all emergency exits utilizing a fixed color camera.
    - b. Record cameras on a 24 hours basis.
    - c. Be programmed go into an alarm state when an emergency exit is opened, and notify the Physical Access Control System and Database Management of an alarm event.
  - 2. IDS:
    - a. Provide a recorded alarm event via a color camera that is connected to the IDS system by either direct hardwire or a security system computer network.
    - b. Record cameras on a 24 hours basis.
    - c. Be programmed to go into an alarm state when an IDS device is put into an alarm state, and notify the PACS.
    - d. For additional VASS System requirements as they relate to the IDS, refer to Section 28 16 00 "INTRUSION DETECTION".
  - 3. Security Access Detection:
    - a. Provide full coverage of all vehicle and lobby entrance screening areas utilizing a fixed color camera.
    - b. Record cameras on a 24 hours basis.
    - c. The VASS System should have facial recognition software to assist in identifying individuals for current and future purposes.
  - 4. EPPS:
    - a. Provide a recorded alarm event via a color camera that is connected to the EPPS system by either direct hardwire or a security system computer network.
    - b. Record cameras on a 24 hours basis.
    - c. Be programmed to go into an alarm state when an emergency call box or duress alarm/panic device is activated, and notify the Physical Access Control System and Database Management of an alarm event.
- F. Integration with these security subsystems shall be achieved by computer programming or the direct hardwiring of the systems.
- G. For programming purposes refer to the manufacturers requirements for correct system operations. Ensure computers being utilized for system integration meet or exceed the minimum system requirements outlined on the systems software packages.
- H. A complete VASS System shall be comprised of, but not limited to, the following components:
  - 1. Cameras
  - 2. Lenses
  - 3. Video Display Equipment
  - 4. Camera Housings and Mounts
  - 5. Controlling Equipment
  - 6. Recording Devices
  - 7. Wiring and Cables
- I. The Contractor shall visit the site and verify that site conditions are in agreement/compliance with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Contracting Officer in the form of a report. The Contractor shall not take any corrective action without written permission received from the Contracting Officer.
- J. Existing Equipment



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1. The Contractor shall connect to and utilize existing video equipment, video and control signal transmission lines, and devices as outlined in the design package. Video equipment and signal lines that are usable in their original configuration without modification may be reused with Contracting Officer approval.
  2. The Contractor shall perform a field survey, including testing and inspection of all existing video equipment and signal lines intended to be incorporated into the VASS System, and furnish a report to the Contracting Officer as part of the site survey report. For those items considered nonfunctioning, provide (with the report) specification sheets, or written functional requirements to support the findings and the estimated cost to correct the deficiency. As part of the report, the Contractor shall include a schedule for connection to all existing equipment.
  3. The Contractor shall make written requests and obtain approval prior to disconnecting any signal lines and equipment, and creating equipment downtime. Such work shall proceed only after receiving Contracting Officer approval of these requests. If any device fails after the Contractor has commenced work on that device, signal or control line, the Contractor shall diagnose the failure and perform any necessary corrections to the equipment.
  4. The Contractor shall be held responsible for repair costs due to Contractor negligence, abuse, or incorrect installation of equipment.
  5. The Contracting Officer shall be provided a full list of all equipment that is to be removed or replaced by the Contractor, to include description and serial/manufacturer numbers where possible. The Contractor shall dispose of all equipment that has been removed or replaced based upon approval of the Contracting Officer after reviewing the equipment removal list. In all areas where equipment is removed or replaced the Contractor shall repair those areas to match the current existing conditions.
- K. Enclosure Penetrations: All enclosure penetrations shall be from the bottom of the enclosure unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and all penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water and will comply with VA Master Specification 07 84 00, Firestopping. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer and in such a manner that the cable is not damaged.
- L. Cold Galvanizing: All field welds and brazing on factory galvanized boxes, enclosures, and conduits shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.
- M. Interconnection of Console Video Equipment: The Contractor shall connect signal paths between video equipment as specified by the OEM. Cables shall be as short as practicable for each signal path without causing strain at the connectors. Rack mounted equipment on slide mounts shall have cables of sufficient length to allow full extension of the slide rails from the rack.
- N. Cameras:
1. Install the cameras with the focal length lens as indicated for each zone.
  2. Connect power and signal lines to the camera.
  3. Aim camera to give field of view as needed to cover the alarm zone.
  4. Aim fixed mounted cameras installed outdoors facing the rising or setting sun sufficiently below the horizon to preclude the camera looking directly at the sun.
  5. Focus the lens to give a sharp picture (to include checking for day and night focus and image quality) over the entire field of view
  6. Synchronize all cameras so the picture does not roll on the monitor when cameras are selected.
  7. PTZ cameras shall have all preset positions and privacy areas defined and programmed.
- O. Monitors:

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1. Install the monitors as shown and specified in design and construction documents.
  2. Connect all signal inputs and outputs as shown and specified.
  3. Terminate video input signals as required.
  4. Connect the monitor to AC power.
- P. Switcher:
1. Install the switcher as shown in the design and construction documents, and according to the OEM.
  2. Connect all subassemblies as specified by the manufacturer and as shown.
  3. Connect video signal inputs and outputs as shown and specified; terminate video inputs as required.
  4. Connect alarm signal inputs and outputs as shown and specified; connect control signal inputs and outputs for ancillary equipment or secondary control/monitoring sites as specified by the manufacturer and as shown.
  5. Connect the switcher CPU and switcher subassemblies to AC power.
  6. Load all software as specified and required for an operational VASS System configured for the site and building requirements, including data bases, operational parameters, and system, command, and application programs.
  7. Provide the original and 2 backup copies for all accepted software upon successful completion of the endurance test.
  8. Program the video annotation for each camera.
- Q. Video Encoder/Decoder
1. Install the Video Encoder/Decoder per design and construction documents, and as specified by the OEM.
  2. Connect analog camera inputs to video encoder.
  3. 3. Connect network camera to video decoder.
  4. Connect video encoder to VASS network.
  5. 5. Connect video decoder to video matrix, DVR, monitor etc.
  6. Connect unit to AC power (UPS).
  7. Configure the video encoder/decoder per manufacturer's recommendation and project requirements.
- R. Video Server:
1. Install the video server per design and construction documents, and as specified by the OEM.
  2. Connect video server to AC power (UPS).
  3. Connect to VASS network.
  4. Install operating system and Video Management Software.
  5. Provide Video Management Software programming per VA guidance and the requirements provided by the Owner. Programming shall include:
    - a. Camera names
    - b. Screen views
    - c. Camera recording schedules (continuous and event) driven recording. Events include alarms from other systems (sensors), manual input, and video motion detection.
    - d. Video detection zones for each camera requiring video motion detection
    - e. Alarm interface
    - f. Alarm outputs
    - g. GUI maps, views, icons and actions
    - h. PTZ controls (presets, time schedules for privacy zones etc.)
    - i. Reports
- S. Video Workstation:
1. Install the video workstation per design and construction documents, and as specified by the OEM.

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2. Connect video workstation to AC power (UPS).
  3. Connect to VASS network.
  4. Install operating system and application software.
  5. Provide application software programming per VA guidance and the requirements provided by the Owner. Programming shall include:
    - a. Screen views
    - b. Graphical User Interface (GUI) maps, views, icons and actions
    - c. Alarm outputs
    - d. Reports
- T. Network Switch:
1. Install the network switch per design and construction documents, and as specified by the OEM.
  2. Connect network switch to AC power (UPS).
  3. Connect network cameras to network switch.
  4. Configure the network switch per manufacturer's recommendation and project requirements.
- U. Network Recording Equipment
1. Install the NVR or video storage unit as shown in the design and construction documents, and as specified by the OEM.
  2. Connect recording device to AC power (UPS).
  3. Connect recording device to network switch as shown and specified.
  4. Configure network connections
  5. Provide recording unit programming per VA guidance and the requirements provided by the Owner. Programming shall include:
    - a. Camera names
    - b. Screen views
    - c. Camera recording schedules (continuous and event) driven recording. Events include alarms from other systems (sensors), manual input, and video motion detection.
    - d. Video detection zones for each camera requiring video motion detection
    - e. Alarm interface
    - f. Alarm outputs
    - g. GUI maps, views, icons and actions
    - h. PTZ controls (presets, time schedules for privacy zones etc.)
    - i. Reports
- V. Video Recording Equipment:
1. Install the video recording equipment as shown in the design and construction documents, and as specified by the OEM.
  2. Connect video signal inputs and outputs as shown and specified.
  3. Connect alarm signal inputs and outputs as shown and specified.
  4. Connect video recording equipment to AC power.
  5. Program the video recording equipment;
    - a. Recording schedules
    - b. Camera caption
- W. Video Signal Equipment:
1. Install the video signal equipment as shown in the design and construction documents, and as specified by the OEM.
  2. Connect video or signal inputs and outputs as shown and specified.
  3. Terminate video inputs as required.
  4. Connect alarm signal inputs and outputs as required.
  5. Connect control signal inputs and outputs as required
  6. Connect electrically powered equipment to AC power.

- X. Camera Housings, Mounts, and Poles:
1. Install the camera housings and mounts as specified by the manufacturer and as shown, provide mounting hardware sized appropriately to secure each camera, housing and mount with maximum wind and ice loading encountered at the site.
  2. Provide a foundation for each camera pole as specified and shown.
  3. Provide a ground rod for each camera pole and connect the camera pole to the ground rod as specified in Division 26 of the VA Master Specification and the VA Electrical Manual 730.
  4. Provide electrical and signal transmission cabling to the mount location via a hardened carrier system from the Physical Access Control System and Database Management to the device.
  5. Connect signal lines and AC power to the housing interfaces.
  6. Connect pole wiring harness to camera.

### **3.03 SYSTEM START-UP**

- A. The Contractor shall not apply power to the VASS System until the following items have been completed:
1. VASS System equipment items and have been set up in accordance with manufacturer's instructions.
  2. A visual inspection of the VASS System has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
  3. System wiring has been tested and verified as correctly connected as indicated.
  4. All system grounding and transient protection systems have been verified as installed and connected as indicated.
  5. Power supplies to be connected to the VASS System have been verified as the correct voltage, phasing, and frequency as indicated.
- B. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior notice.
- C. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage as a result of Contractor work efforts.

### **3.04 SUPPLEMENTAL CONTRACTOR QUALITY CONTROL**

- A. The Contractor shall provide the services of technical representatives who are familiar with all components and installation procedures of the installed VASS System; and are approved by the Contracting Officer.
- B. The Contractor will be present on the job site during the preparatory and initial phases of quality control to provide technical assistance.
- C. The Contractor shall also be available on an as needed basis to provide assistance with follow-up phases of quality control.
- D. The Contractor shall participate in the testing and validation of the system and shall provide certification that the system installed is fully operational as all construction document requirements have been fulfilled.

### **3.05 COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of Section 28 08 00 – COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 28 08 00 – “COMMISSIONING OF ELECTRONIC SAFETY AND

SECURITY SYSTEMS” and related sections for contractor responsibilities for system commissioning.

**3.06 DEMONSTRATION AND TRAINING**

- A. All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, “GENERAL REQUIREMENTS”.
- B. Provide services of manufacturer’s technical representative for [four] hours to instruct VA personnel in operation and maintenance of units.
- C. Submit training plans and instructor qualifications in accordance with the requirements of Section 28 08 00 – “COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS”.

**END OF SECTION**

**SECTION 282600**  
**ELECTRONIC PERSONAL PROTECTION SYSTEM**

**PART 1 – GENERAL**

**1.01 DESCRIPTION**

- A. Provide and install complete Duress-Panic Alarms, Emergency Phones/ Call-Boxes, and Intercom Systems, data transmission wiring and a control station with its associated equipment, hereafter referred to as EPPS System.
- B. EPPS shall be integrated with monitoring and control system specified in Division 28 Section [VIDEO SURVEILLANCE SYSTEMS] [INTRUSION DETECTION] [PHYSICAL ACCESS CONTROL SYSTEM] that specifies systems integration.

**1.02 RELATED WORK**

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- B. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping application and use.
- C. Section 10 14 00 - SIGNAGE. Requirements for labeling and signs.
- D. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.
- E. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.
- F. Section 28 05 28.33 - CONDUITS AND BACK BOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.
- G. Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY. Requirements for requirements for commissioning - systems readiness checklists, and training.
- H. Section 28 13 00 - PHYSICAL ACCESS CONTROL SYSTEMS (PACS). Requirements for physical access control integration.
- I. Section 28 13 16 - ACCESS CONTROL SYSTEM AND DATABASE MANAGEMENT. Requirements for control and operation of all security systems.
- J. Section 28 16 00 - INTRUSION DETECTION SYSTEM. Requirements for integration with intrusion detection system.
- K. Section 28 13 53 - SECURITY ACCESS DETECTION. Requirements for security access detection.
- L. Section 28 23 00 - VIDEO SURVEILLANCE. Requirements for security camera systems.

**1.03 QUALITY ASSURANCE**

- A. The Contractor shall be responsible for providing, installing, and the operation of the EPPS System as shown. The Contractor shall also provide certification as required.
- B. The security system shall be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the security system is stand-alone or a part of a complete Information Technology (IT) computer network.
- C. The Contractor or security sub-contractor shall be a licensed security Contractor as required within the state or jurisdiction of where the installation work is being conducted.
- D. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.
- E. Product Qualification:
  - 1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.

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2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.
- F. Contractor Qualification:
1. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years experience installing and servicing systems of similar scope and complexity. The Contractor shall be an authorized regional representative of the Security Management System's (PACS) manufacturer. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity which became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system. The references must include a current point of contact, company or agency name, address, telephone number, complete system description, date of completion, and approximate cost of the project. The owner reserves the option to visit the reference sites, with the site owner's permission and representative, to verify the quality of installation and the references' level of satisfaction with the system. The Contractor shall provide copies of system manufacturer certification for all technicians. The Contractor shall only utilize factory-trained technicians to install, program, and service the PACS. The Contractor shall only utilize factory-trained technicians to install, terminate and service controller/field panels and reader modules. The technicians shall have a minimum of five (5) continuous years of technical experience in electronic security systems. The Contractor shall have a local service facility. The facility shall be located within 60 miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with this contract. The facility shall also include appropriate diagnostic equipment to perform diagnostic procedures. The COTR reserves the option of surveying the company's facility to verify the service inventory and presence of a local service organization.
  2. The Contractor shall provide proof project superintendent with BICSI Certified Commercial Installer Level 1, Level 2, or Technician to provide oversight of the project.
  3. Cable installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International. The staff member shall provide consistent oversight of the project cabling throughout design, layout, installation, termination and testing.
- G. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within eight hours of receipt of notification that service is needed. Submit name and address of service organizations.

#### 1.04 SUBMITALS

- A. Submit below items in accordance with Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY and Master Specification Sections 01 33 23, SHOP DRAWING, PRODUCT DATA, AND SAMPLES, and Section 02 41 00, DEMOLITION.
- B. Provide certificates of compliance with Section 1.3, Quality Assurance.
- C. Provide a pre-installation and as-built design package in both electronic format and on paper, minimum size 48 x 48 inches (1220 x 1220 millimeters); drawing submittals shall be per the established project schedule.
- D. Shop drawings and as-built packages shall include, but not be limited to:
  1. Index Sheet that shall:
    - a. Define each page of the design package to include facility name, building name, floor, and sheet number.
    - b. Provide a list of all security abbreviations and symbols.
    - c. Reference all general notes that are utilized within the design package.
    - d. Specification and scope of work pages for all security systems that are applicable to the design package that will:

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- 1) Outline all general and job specific work required within the design package.
  - 2) Provide a device identification table outlining device Identification (ID) and use for all security systems equipment utilized in the design package.
  2. Drawing sheets that will be plotted on the individual floor plans or site plans shall:
    - a. Include a title block as defined above.
    - b. Define the drawings scale in both standard and metric measurements.
    - c. Provide device identification and location.
    - d. Address all signal and power conduit runs and sizes that are associated with the design of the electronic security system and other security elements (e.g., barriers, etc.).
    - e. Identify all pull box and conduit locations, sizes, and fill capacities.
    - f. Address all general and drawing specific notes for a particular drawing sheet.
  3. A riser drawing for each applicable security subsystem shall:
    - a. Indicate the sequence of operation.
    - b. Relationship of integrated components on one diagram.
    - c. Include the number, size, identification, and maximum lengths of interconnecting wires.
    - d. Wire/cable types shall be defined by a wire and cable schedule. The schedule shall utilize a lettering system that will correspond to the wire/cable it represents (example: A = 18 AWG/1 Pair Twisted, Unshielded). This schedule shall also provide the manufacturer's name and part number for the wire/cable being installed.
  4. A system drawing for each applicable security system shall:
    - a. Identify how all equipment within the system, from main panel to device, shall be laid out and connected.
    - b. Provide full detail of all system components wiring from point-to-point.
    - c. Identify wire types utilized for connection, interconnection with associate security subsystems.
    - d. Show device locations that correspond to the floor plans.
    - e. All general and drawing specific notes shall be included with the system drawings.
  5. A schedule for all of the applicable security subsystems shall be included. All schedules shall provide the following information:
    - a. Device ID.
    - b. Device Location (e.g. site, building, floor, room number, location, and description).
    - c. Mounting type (e.g. flush, wall, surface, etc.).
    - d. Power supply or circuit breaker and power panel number.
  6. Detail and elevation drawings for all devices that define how they were installed and mounted.
- E. Pre-installation design packages shall be reviewed by the Contractor along with a VA representative to ensure all work has been clearly defined and completed. All reviews shall be conducted in accordance with the project schedule. There shall be four (4) stages to the review process:
1. 35 percent
  2. 65 percent
  3. 90 percent
  4. 100 percent
- F. Provide manufacturer security system product cut-sheets. Submit for approval at least 30 days prior to commencement of formal testing, a Security System Operational Test Plan. Include procedures for operational testing of each component and security subsystem, to include performance of an integrated system test.
- G. Submit manufacture's certification of Underwriters Laboratories, Inc. (UL) listing as specified. Provide all maintenance and operating manuals per the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.



### **1.05 APPLICABLE PUBLICATIONS**

- A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI):
  - 1. ASNI S3,2-09 - Method for measuring the Intelligibility of Speech over Communications Systems
- C. Department of Justice American Disability Act (ADA)
  - 1. 28 CFR Part 36 - 2010 ADA Standards for Accessible Design
- D. Federal Communications Commision (FCC):
  - 1. (47 CFR 15) Part 15 - Limitations on the Use of Wireless Equipment/Systems
- E. National Fire Protection Association (NFPA):
  - 1. 70-11 - National Electrical Code
- F. National Electrical Manufactures Association (NEMA)
  - 1. 250-08 - Enclosures for Electrical Equipment (1000 Volts Maximum)
- G. Underwriters Laboratories, Inc. (UL):
  - 1. 305-08 - Standard for Panic Hardware
  - 2. 444-08 - Safety Communications Cables
  - 3. 636-01 - Standard for Holdup Alarm Units and Systems
- H. Uniform Federal Accessibility Standards (UFAS), 1984

### **1.06 COORDINATION**

- A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed.

### **1.07 MAINTENANCE & SERVICE**

- A. General Requirements
  - 1. The Contractor shall provide all services required and equipment necessary to maintain the entire integrated electronic security system in an operational state as specified for a period of one (1) year after formal written acceptance of the system. The Contractor shall provide all necessary material required for performing scheduled adjustments or other non-scheduled work. Impacts on facility operations shall be minimized when performing scheduled adjustments or other non-scheduled work. See also General Project Requirements.
- B. Description of Work
  - 1. The adjustment and repair of the security system includes all software updates, panel firmware, and the following new items computers equipment, communications transmission equipment and data transmission media (DTM), local processors, security system sensors, facility interface, and signal transmission equipment.

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C. Personnel

1. Service personnel shall be certified in the maintenance and repair of the selected type of equipment and qualified to accomplish all work promptly and satisfactorily. The COTR shall be advised in writing of the name of the designated service representative, and of any change in personnel. The COTR shall be provided copies of system manufacturer certification for the designated service representative.

D. Schedule of Work

1. The work shall be performed during regular working hours, Monday through Friday, excluding federal holidays. These inspections shall include:
  - a. The Contractor shall perform two (2) minor inspections at six (6) month intervals or more if required by the manufacturer, and two (2) major inspections offset equally between the minor inspections to effect quarterly inspection of alternating magnitude.
    - 1) Minor Inspections shall include visual checks and operational tests of all console equipment, peripheral equipment, local processors, sensors, electrical and mechanical controls, and adjustments on printers.
    - 2) Major Inspections shall include all work described for Minor Inspections and the following: clean all system equipment and local processors including interior and exterior surfaces; perform diagnostics on all equipment; operational tests of the CPU, switcher, peripheral equipment, check and calibrate each sensor; run all system software diagnostics and correct all problems; and resolve any previous outstanding problems.

E. Emergency Service

1. The owner shall initiate service calls whenever the system is not functioning properly. The Contractor shall provide the Owner with an emergency service center telephone number. The emergency service center shall be staffed 24 hours a day 365 days a year. The Owner shall have sole authority for determining catastrophic and non-catastrophic system failures within parameters stated in General Project Requirements.
  - a. For catastrophic system failures, the Contractor shall provide same day four (4) hour service response with a defect correction time not to exceed eight (8) hours from [notification] [arrival on site]. Catastrophic system failures are defined as any system failure that the Owner determines will place the facility(s) at increased risk.
  - b. For non-catastrophic failures, the Contractor within eight (8) hours with a defect correction time not to exceed 24 hours from notification.

F. Operation

1. Performance of scheduled adjustments and repair shall verify operation of the system as demonstrated by the applicable portions of the performance verification test.

G. Records & Logs

1. The Contractor shall maintain records and logs of each task and organize cumulative records for each component and for the complete system chronologically. A continuous log shall be submitted for all devices. The log shall contain all initial settings, calibration, repair, and programming data. Complete logs shall be maintained and available for inspection on site, demonstrating planned and systematic adjustments and repairs have been accomplished for the system.

H. Work Request

1. The Contractor shall separately record each service call request, as received. The record shall include the serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing the action taken, the amount and nature of the materials used, and the date and time of commencement and completion. The Contractor shall deliver a record of the work performed within five (5) working days after the work was completed.

I. System Modifications

1. The Contractor shall make any recommendations for system modification in writing to the COTR. No system modifications, including operating parameters and control settings, shall be made without prior written approval from the COTR. Any modifications made to the system shall be incorporated into the operation and maintenance manuals and other documentation affected.
- J. Software
1. The Contractor shall provide all software updates when approved by the Owner from the manufacturer during the installation and 12-month warranty period and verify operation of the system. These updates shall be accomplished in a timely manner, fully coordinated with the system operators, and incorporated into the operations and maintenance manuals and software documentation. There shall be at least one (1) scheduled update near the end of the first year's warranty period, at which time the Contractor shall install and validate the latest released version of the Manufacturer's software. All software changes shall be recorded in a log maintained in the unit control room. An electronic copy of the software update shall be maintained within the log. At a minimum, the contractor shall provide a description of the modification, when the modification occurred, and name and contact information of the individual performing the modification. The log shall be maintained in a white 3 ring binder and the cover marked "SOFTWARE CHANGE LOG".

#### **1.08 WARRANTY OF CONSTRUCTION.**

- A. Warrant EPPS System work subject to the Article "Warranty of Construction" of FAR clause 52.246-21.
- B. Demonstration and training shall be performed prior to system acceptance.

#### **1.09 GENERAL REQUIREMENTS**

- A. For general requirements that are common to more than one section in Division 28 refer to Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
- B. General requirements applicable to this section include:
  1. Performance Requirements,
  2. Delivery, Handling and Storage,
  3. Project Conditions,
  4. Equipment and Materials,
  5. Electrical Power,
  6. Lightning, Power Surge Suppression, and Grounding,
  7. Electronic Components,
  8. Substitute Materials and Equipment, and
  9. Like Items.

### **PART 2 – PRODUCTS**

#### **2.01 EQUIPMENT AND MATERIALS**

- A. General
- B. All equipment shall be rated for continuous operation. Environmental conditions (i.e. temperature, humidity, wind, and seismic activity) shall be taken under consideration at each facility and site location prior to installation of the equipment.
- C. All equipment shall operate on a 120 or 240 volts alternating current (VAC); 50 hertz (Hz) or 60 Hz Alternating Current (AC) power system unless documented otherwise in subsequent sections listed within this spec. All equipment shall have a battery back-up source of power that will provide 12 hours (hrs.) of run time in the event of a loss of primary power to the security systems until a backup generator comes on-line.
- D. The EPPS systems shall be designed, installed, and programmed in a manner that will allow for easy of operation, programming, servicing, maintenance, testing, and upgrading of the system.

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- E. All EPPS components located in designated "HAZARDOUS ENVIRONMENT" areas where fire or explosion could occur due to the presence of natural gases or vapors, flammable liquids, combustible residue, or ignitable fibers or debris, shall be rated Class II, Division I, Group F, and installed in accordance with National Fire Protection Association (NFPA) 70, National Electrical Code Chapter 5.
- F. The Contractor shall provide the Contracting Officer with written verification, that the type of wire/cable being provided is recommended and approved by the OEM. Cabling shall meet the interconnecting wiring requirements of NFPA 70, National Electrical Code. The Contractor is responsible for providing the correct protection cable duct and/or conduit and wiring.
- G. When interfacing with other communications or security subsystems the Contractor shall utilize interfacing methods that are approved by the Contracting Officer. At a minimum, an acceptable interfacing method requires not only a physical and mechanical connection; but also a matching of signal, voltage, and processing levels with regard to signal quality and impedance. The interface point must adhere to all standards described herein.
- H. Systems shall be scaleable, not vendor specific, and allow expansion as required.
- I. Wireless systems shall use ultrasonic, infrared and radio frequency waves to link distributed transmitters and receivers. Specific characteristics of particular facility will determine best application. Contractor is responsible for determining best system using prediction program to determine where readable signals can be obtained and identify "dead spots".
- J. All hardwired alarms, switches, and junction boxes shall be protected from tampering and include line supervision.
- K. The installation and placement of intercom units and emergency-call boxes in strategic locations shall also require that signage be posted near these devices. The signage, in accordance with Section 10 14 00, SIGNAGE shall communicate the location of the device and its unique identification number, and brief instruction on how to access/use the device. The signage may appear on the device, on a pole or wall near the device location and shall be printed in a manner that is easily read during daylight and hours of darkness.

## 2.02 EQUIPMENT ITEMS

- A. All systems shall be designed to provide continuous electrical supervision of the complete and entire system.
- B. Noise filters and surge protectors shall be provided for all intercommunications equipment to ensure protection from primary AC power surges and to ensure noise interference is not induced into low voltage data circuits.
- C. All alarm and initiating and signaling circuits shall be supervised for open circuits, short circuits, and system grounds. Main and Uninterrupted Power Supply (UPS) power circuits shall be supervised for any change in operating conditions (e.g. low battery, primary to back up battery, and UPS online). When an open, short or ground occurs in any system circuit, an audible and visual fault alarm signal shall be initiated at the master control station and all remote locations.
- D. Control Unit: Shall consist of the components to constantly monitor and verify alarm activation; identify zone of activation and location of activation.
- E. Audible Signal Device for Duress-Panic: Provides alarm activation and audible sound for alarms, as well as supervisory and trouble signals that shall be distinctive.
- F. Assessment: This capability shall consist of electronic devices required to visually and audibly verify the validity of alarms. Assessment also includes providing indication of tampering, fail-safe, low battery, and power losses.
- G. Alarm Monitoring and Reporting: Shall annunciate information to at least two (2) separate locations. The alarms shall maintain the capability to respond with local and remote visible and audible signals upon activation of an alarm. The alarms shall have the capability of operating in a silent mode, alerting personnel monitoring the system that the device has been activated.

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- H. The intercom and emergency call-box systems shall be provided with normally acceptable speech intelligibility, defined as a score of at least 70% in accordance with ANSI S3.2
- I. Master Stations for Emergency Call Box and Security Intercoms:
  - 1. All master stations shall have a "call-in" switch to provide an audible and visual indication of incoming calls from remote stations. Individual visual indication shall identify the calling station and status, and remain actuated until a call is answered by a master station.
  - 2. Master stations shall be equipped with a handset with a switch for private conversations.
  - 3. Intercom master stations shall also have an all-call feature, and have the ability to receive video from a video intercom unit.
  - 4. Master stations shall have the capability to selectively communicate with any remote station by actuating assigned station number on a keypad or select button for that station.
  - 5. Master stations may be standalone or can be integrated with the Physical Access Control System and Database Management. The Contractor will be responsible for the integration of the Master station with the Physical Access Control System and Database Management in accordance with OEM instructions and Section 28 13 16, PHYSICAL ACCESS CONTROL SYSTEM AND DATABASE MANAGEMENT.
- J. Duress-Panic Alarms:
  - 1. Housing shall be a rugged corrosion-resistant housing of stainless steel or Acrylonitrile Butadiene Styrene (ABS) molded plastic or similar material that is weather and dust proof.
  - 2. Actuating device shall include a minimum of a plunger button whose head is recessed from the face/front edge of the housing and be designed to avoid accidental activation using switch guard or multiple buttons (i.e., requires pressing two (2) buttons simultaneously)
  - 3. Wireless stationary devices will meet the same specifications as Personal Duress/Panic Alarms.
  - 4. Alarm switch/button shall lock-in upon activation until manually reset with key or manufacture provided device.
  - 5. The switch shall be a positive-acting, double-pole, and double-throw switch.
  - 6. Duress/Panic alarms shall meet UL 305 Standard for Panic Alarms. To reduce the possibility of false alarms and ensure installation functionality UL 636 Standard for Holdup Alarms standards shall be met.
  - 7. Alarms used for concealed application requires silent alarm notification to a monitoring station. They shall annunciate at the Physical Access Control System and Database Management, monitored by a central station or direct connect to local police, depending on local ordinance requirements.
  - 8. Shall be capable of being mounted for hand or foot use in a manner that is unable to be viewed by the public. Larger systems use a computer that intercepts and processes alarms and displays them on a monitor. The central computer can make an announcement over facility hand held radios, pagers or telephones, or at the Physical Access Control System and Database Management so that the other security personnel can be immediately notified. These systems shall be hardwired.
  - 9. Components:
    - a. Transmitter
    - b. Locator subsystem
    - c. Receiver
    - d. Software
  - 10. Wiring will be four (4) conductor #18 American Wire Gauge (AWG).
  - 11. Duress-Panic Alarm Technical Characteristics:

Temperature Range	0° to 110°F (-17.8°C to 43.3°C)
Nominal Voltage	12 V DC @ 6 mA
Current	Max 8 mA
Operational Voltage	7 V DC to 15 V DC

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Operational life	Rated for 0,000 activations
Battery Activations	500
Actuator	Dual button plunger with activation lock
LED	Bi-color – on and activated

K. Personal Duress-Panic Alarm:

1. These systems are wireless only and can be worn as a belt clip, with a neck lanyard or with a wrist band. These alarms can be either active (manually operated) or passive mode (if detached from body, or body position changes to a prone position) alarm activates. They also provide identification of individual and location.
2. Components:
  - a. Transmitter
  - b. Repeaters (for wireless and increase distance)
  - c. Locator subsystem
  - d. Receiver
  - e. Software
3. Wireless transmitters shall send a periodic check in signal to the main computer or processor. If the signal is not received according to a definable time window, a supervisory alert will be generated. Wireless devices shall report a low battery condition well in advance to the failure of the battery.
4. Shall consist of a compact lightweight transmitter enclosed in a durable fire-retardant ABS plastic case that can be easily worn.
5. Transmitters may use ultrasonic, radio frequency (RF), or infrared (IR) to transmit signals. Each has advantages and disadvantages. Selection of system shall be dependent on defined usage and range of communications required.
6. Sensors shall be adjustable to activate automatically when mounted on a belt and the user is in a horizontal position for longer than one (1) to fifteen (15) minutes. Adjustment capability shall not be accessible to personnel wearing the panic alarm device.
7. Radio frequencies for transmitter will comply with Federal Communication Commission (FCC) regulations.
8. Radio frequency transmitters will use frequency modulation signal hopping.
9. Personal Duress-Panic Alarm Technical Characteristics:

Temperature Range	0° to 110°F (-17.8°C to 43.3°C)
Nominal Voltage	12 V DC @ 6 mA
Current	Max 8 mA
Operational Voltage	7 V DC to 15 V DC
Battery Life	Regular battery 60 hour duration or Nickel-Metal Hydride (NiMH) rechargeable 12 hrs. 20 hr. per charge
Battery Lifespan	500 activations
Actuator	Plunger with activation lock
LED	Bi-color – on and activated
Passive Activation	Adjustable Prone position 1-15 minutes

L. Emergency Call Box Enclosures:

1. Consist of remote call stations, master station and a telephone Private Branch Exchange (PBX). They shall have two-way voice communications. Calls are directed to a pre-programmed extension. These systems are effective for a multi-facility environment or stand-alone facility with a parking structure or large parking lot. In addition, they may contain built-in CCTV system capabilities or can be integrated to work with standalone CCTV systems.

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2. Emergency Call Boxes will be housed in an National Electric Manufactures Association (NEMA) 250 Enclosures for Electrical Equipment compliant enclosures. Call-box enclosure shall include blue light/or similar strobe mounted behind or on top of the call box: A blue light or color lit strobe shall be activated (e.g. to inform others visually that assistance is required) when the emergency switch/button/phone is pressed/taken off-hook and shall flash for the duration of a call.
3. The faceplate shall be constantly lit by ultra bright LEDs.
4. Enclosure and bracket system shall be designed to resist extreme weather conditions and constructed of weather resistant stainless steel.
5. Emergency Call Box Enclosure Technical Characteristics:

Construction	Minimum 11 gauge stainless steel Impact resistant polycarbonate window for lights
Mounting	Wall, pole or kiosk
Power	120 VAC: 44 Watts Maximum or 24 VDC: 18 Watts Maximum
Lighting	Strobe: 1.5 million candlepower 70 flashes per minute. Blue Light: 7 watt high efficiency 10,000 hour compact fluorescent. Faceplate Light: Ultra bright LEDs 100,000 hour lifetime.

M. Emergency Call Boxes:

1. Emergency Call Box shall be indoor/outdoor-rated, Uniform Federal Accessibility Standards (UFAS) and Americans with Disability Act (ADA) compliant, and provide hands-free usage. Phone shall also include cast metal raised letter and Braille signage for UFAS/ADA compliance.
2. Emergency Call Box shall include built-in auto-dialer that dials two (2) numbers: if first number doesn't answer, automatically dials a second number.
3. The System shall include auto-answer to allow for monitoring and initiating calls with an Emergency Phone.
4. Emergency Call Box shall use flush mount enclosure (FME,) shall include two (2) piece housing construction with full front lip to allow tight gasket seal between the speakerphone and enclosure. Screws shall be tamper free.
5. When activated the Emergency Call Box shall automatically place a call to the pre-programmed number(s). If the number is busy it should automatically call a second number.
6. The electronics enclosure shall be capable of using interchangeable faceplates: a single-button faceplate, a two-button faceplate, or a two-button faceplate with keypad.
7. The system shall use a "plain old telephone service" (POTS) line or analog PBX and shall be capable of integration with existing CCTV and Physical Access Control System and Database Management via software at the SMS head-end.
8. Depending on distance and existing phone line capabilities, RF or use of wireless phone connections may be considered. The Contractor and Contracting Officer shall select appropriate system based on facility telecommunication system capabilities and desired system requirements.
9. Monitoring/Diagnostic capability at control and monitoring stations shall include the capability to automatically poll each Emergency Call Box, report incoming calls, identify location, and keep permanent records of all events with the use of a Windows based compatible software package and shall also meet the requirements of the Security Management System (SMS).

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- a. If speaker/handset stations are used, lifting the handset shall automatically cut out the loudspeaker in the station and all conversation shall be carried through the handset. Where noise does not exceed 55 dB, hands-free operations may be performed from distances up to 20 feet (ft.) (6.096 m). In higher noise environments only a talk-listen switch shall be utilized.
- b. If system is a hardware type master station it shall be capable of:
  - 1) LED display of identification code for emergency phones;
  - 2) Indicate whether call was initiated by pushing button or by an auxiliary device;
  - 3) Include RJ11 ports for connection to telephone line and standard telephone; and
  - 4) Powered by 9 VDC, 500mA power supply that connects to 120 volt alternating current (VAC).
- c. System shall include auto-answer to allow security to monitor and initiate calls with Emergency Call Box.
- d. Contractor shall provide the capability to connect up to 8 phones on one (1) phone line while retaining ability to call each phone individually and without affecting performance. System shall also be able to create a closed system without need for any phone lines.
- e. The System shall include the capability to record a message identifying the location of the caller.
- f. It shall remotely be able to adjust speakerphone & microphone sensitivity.
- g. Emergency Call Box Technical Characteristics:

Construction	12 gauge (2.8mm) #4 brushed stainless steel face plate
Operating Temperature	-4°F to +149°F (-20°C to +65°C)
Communication	2-way hands-free communication
Digital Capacity	Up to 18 digits, including pauses, for each of two (2) phone numbers
Dialing Speed	Minimum 10 tones per second
Power Source	Phone line powered (requires 20mA at 24 v off-hook)
Connection	Parallel tip and ring connected to RJ11 connector for quick installation
Memory	Erasable Programmable Read-only Memory (EPROM)
Circuit Protection	Lightening suppressed and full wave polarity guarded
Programming	Non-volatile EEPROM programming can be done from any telephone. No battery back-up needed
Wiring Requirements	1 twisted-shielded pair (gauge depends on distance)
Camera	Option for pin-hole color camera or Integration with existing CCTV
LED	Call confirmation
Activation	Sound or 1.5 in. minimum piezoelectric button
Labeling	"Push for Help" or "Emergency"

N. Strobes and Beacon:



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1. Used for visual recognition of device activation once an emergency phone or intercom is activated. They provide unit identification and quick location of the caller.
2. Strobes and Beacons Technical Characteristics:

STROBE	
Input Voltage	10.5 – 28 VDC or VAC
Input Current	Average 1 amp
Input Current	Peak 3 amp
Intensity	1,000,000 candlepower
Control Circuit Output	2 mA max
Flash Rate	60 – 75 times per minute
BEACON	
Input Voltage	10.5 - 28 VAC or VDC
Input Current	@24.0 : 427 MA

O. Security Intercoms:

1. Shall be utilized to assist in controlling entry to a site, parking lot, facility, main and alternate entries, loading dock areas. They are also used for emergencies. These systems shall have both two-way voice communications and video (CCTV) capabilities built in. Intercoms may also have key-pads that allow for specific call connections or may provide a directory. These systems consist of both remote and master stations. Intercom shall be externally powered for distances over 1,500 feet (457.2 meters) (m) from the master control unit.
2. The Intercom shall be programmable from a remote location and have a three number dialing capability per activation button, or include a keypad for dialing authorized and published extensions.
3. The Intercom shall have an internally mounted electronics enclosure and auxiliary power.
4. The Contractor shall be responsible for integration of intercom with auxiliary output to electronic or magnetic door releases, as well as CCTV, as required.
5. Security Intercom Technical Characteristics:

Construction	12 gauge (2.8mm) #4 brushed stainless steel face plate
Operating Temperature	-4°F to +149°F (-20°C to +65°C)
Communication	2-way hands-free communication
Digital Capacity	Up to 18 digits, including pauses, for each of two (2) phone numbers
Dialing Speed	Minimum 10 tones per second
Power Source	Phone line powered or PBX
Connection	Parallel tip and ring connected to RJ11 connector for quick installation
Memory	EPROM
Circuit Protection	Lightening suppressed and full wave polarity guarded
Programming	Non-volatile EEPROM programming can be done from any telephone. No battery back-up needed
Wiring Requirements	1 twisted-shielded pair (gauge depends on distance)
Camera	Option for pin-hole color camera or Integration with existing CCTV

LED	Call confirmation
Activation	1.5 in. (38.1mm) minimum piezoelectric button
Labeling	"Information" or "Help"

**2.03 INSTALLATION KIT**

- A. General: A kit shall be provided that, at a minimum, includes all connectors and terminals, labeling systems, barrier strips, wiring blocks or wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, etc., required to accomplish a neat and secure installation. Unfinished or unlabeled wire connections will not be allowed. Contractor shall turn over to the Contracting Officer all unused and partially opened installation kit boxes, coaxial cable reels, conduit, cable tray, and/or cable duct bundles, wire rolls, and physical installation hardware. This is an acceptable alternate to the individual spare equipment requirement as long as the minimum spare items are provided in this count. The following installation sub-kits are required as a minimum:
- B. System Grounding:
  - 1. The grounding kit shall include all cable in accordance with UL 444 Communications Cables, and installation hardware required. All grounding will be according to the NEC.
  - 2. This includes, but is not limited to:
    - a. Coaxial Cable Shields
    - b. Control Cable Shields
    - c. Data Cable Shields
    - d. Conduits
    - e. Cable Duct
    - f. Cable Trays
    - g. Power Panels
    - h. Connector Panels
- C. Coaxial Cable: The coaxial cable kit shall include all coaxial connectors, cable tying straps, heat shrink tabbing, hangers, clamps, etc., required to accomplish a neat and secure installation.
- D. Wire And Cable: The wire and cable kit shall include all connectors and terminals, barrier straps, wiring blocks, wire wrap strips, heat shrink tubing, tie wraps, solder, hangers, clamps, labels etc., required to accomplish a neat and orderly installation.
- E. Equipment Interface: The equipment interface kit shall include any item or quantity of equipment, cable, mounting hardware and materials needed to interface Systems and Subsystems according to the OEM requirements and this specification.
- F. Labels: The labeling kit shall include any item or quantity of labels, tools, stencils, and materials needed to label each subsystem according to the OEM requirements, as-installed drawings, and this specification.
- G. Documentation: The documentation kit shall include any item or quantity of items, computer discs, as installed drawings, equipment, maintenance, and operation manuals, and OEM materials needed to correctly provide the system documentation as required by this document and explained herein.

**PART 3 – EXECUTION**

**3.01 INSTALLATION**

- A. System installation shall be installed in accordance with NFPA 731 Standards for the Installation of Electric Premises Security Systems and appropriate installation manual for each type of subsystem designed, engineered, and installed.
- B. The location and type of duress, intercom, or call-box to be installed will be in accordance with physical security requirements unique to each VA facility.

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- C. For EPPS systems (i.e. use current panic/duress and emergency call boxes) that can operate through existing VA facility telephone system lines, software programming and hardware, refer to Section 27 51 23, INTERCOMMUNICATIONS AND PROGRAM SYSTEMS to integrate additional EPPS equipment.
- D. Concealed duress/panic devices shall be mounted in such a way that their location is only known by the person having knowledge of the activating device location. No wiring shall be exposed to identify the location of the activation device.
- E. Floor mounted duress alarms shall be attached to millwork on floor. When mounted under millwork, wiring shall be routed in millwork to conduit system via flexible conduit.
- F. Hard-wired switches shall be wired to individual alarm points within the Advanced Processing Controller (apC).
- G. Wall and post mounted stations shall be mounted to meet UFAS/ADA requirements and use tamper proof bolts and screws. Testing will be finished before installation of fasteners.
- H. Cleaning: Subsequent to installation, clean each system component of dust, dirt, grease, or oil incurred during installation in accordance to manufacture instructions.
- I. Provisions shall be made for systems in high-noise areas or areas with electrical interference environments.
- J. Adjustment/Alignment/Synchronization: Contractor shall prepare for system activation by following manufacturer's recommended procedures for adjustment, alignment, or programming. Prepare each component in accordance with appropriate provisions of the component's installation, operations, and maintenance instructions.

**3.02 WIRELINE DATA TRANSMISSION**

- A. Installation: The Contractor shall install all system components including Owner furnished equipment, and appurtenances in accordance with the manufacturer's instructions, ANSI C2 and as shown, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable data transmission system.
- B. Identification and Labeling: The Contractor shall supply permanent identification labels for each cable at each end that will appear on the as-built drawings. The labeling format shall be identified and a complete record shall be provided to the Owner with the final documentation. Each cable shall be identified by type or signal being carried and termination points. The labels shall be printed on letter size label sheets that are self laminated vinyl that can be printed from a computer data base or spread sheet. The labels shall be E-Z code WES12112 or equivalent.
- C. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing.
- D. Transient Voltage Surge Suppressors (TVSS): The Contractor shall mount TVSS within 3 m (118 in) of equipment to be protected inside terminal cabinets or suitable NEMA 1 enclosures. Terminate off-premise conductors on input side of device. Connect the output side of the device to the equipment to be protected. Connect ground lug to a low impedance earth ground (less than 10 ohms) via Number 12 AWG insulated, stranded copper conductor.
- E. Contractor's Field Test: The Contractor shall verify the complete operation of the data transmission system during the Contractor's Field Testing. Field test shall include a bit error rate test. The Contractor shall perform the test by sending a minimum of 1,000,000 bits of data on each DTM circuit and measuring the bit error rate. The bit error rate shall not be greater than one (1) bit out of each 100,000 bits sent for each dial-up DTM circuit, and one (1) bit out of 1,000,000 bits sent for each leased or private DTM circuit. The Contractor shall submit a report containing results of the field test.
- F. Acceptance Test and Endurance Test: The wire line data transmission system shall be tested as a part of the completed IDS and EECS during the Acceptance test and Endurance Test as

specified.

- G. Identification and Labeling: The Contractor shall supply identification tags or labels for each cable. Cable shall be labeled at both end points and at intermediate hand holes, manholes, and junction boxes. The labeling format shall be identified and a complete record shall be provided to the Owner with the final documentation. Each cable shall be identified with type of signal being carried and termination points.

### **3.03 WIRING**

- A. Wiring Method: Install cables in raceways [except in accessible indoor ceiling spaces, in attics,] [in hollow gypsum-board partitions,] and as otherwise indicated. Conceal raceways and wiring except in unfinished spaces.
- B. Wiring Method: Install cables concealed in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- D. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- E. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer.

### **3.04 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation and supervise pretesting, testing, and adjusting of video surveillance equipment.
- B. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
- C. Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.
- D. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.
- E. Remove and replace malfunctioning items and retest as specified above.
- F. Record test results for each piece of equipment.
- G. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

### **3.05 ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions and to optimize performance of the installed equipment. Tasks shall include, but are not limited to, the following:
  - 1. Check cable connections.
  - 2. Check proper operation of detectors.
  - 3. Recommend changes to walk through detectors, X-ray machines, and associated equipment to improve Owner' utilization of security access detection system.
  - 4. Provide a written report of adjustments and recommendations.

**3.06 CLEANING**

- A. Clean installed items using methods and materials recommended in writing by manufacturer.

**3.07 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain electronic personal protection system (EPSS) equipment.
  - 1. Train Owner's maintenance personnel on procedures and schedules for troubleshooting, servicing, and maintaining equipment.
  - 2. Demonstrate methods of determining optimum alignment and adjustment of components and settings for system controls.
  - 3. Review equipment list and data in maintenance manuals.
  - 4. Conduct a minimum of [four] hours' training.

**3.08 COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of Section 28 08 00 – COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 28 08 00 – COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS and related sections for contractor responsibilities for system commissioning.

**3.09 TESTS AND TRAINING**

- A. All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS and Section 28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.

**END OF SECTION**

**SECTION 285231  
EMERGENCY CALL SYSTEM**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

- A. This section specifies the complete and operating emergency call system, including instruments (stations), security strobe, stanchions and associated equipment here-in-after referred to as the "system".

**1.02 RELATED WORK**

- A. Electrical conductors and cables in electrical systems rated 600 V and below: Section 26 05 19, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
- B. Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents: Section 28 05 26, GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY SYSTEMS.
- C. Requirements for personal safety and to provide a low impedance path for possible telecommunications ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- D. Voice and data distribution sub-systems, and associated hardware including telecommunications outlets (TCO); copper and fiber optic distribution cables, connectors, "patch" cables, and "break out" devices: Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING.
- E. Conduits and partitioned telecommunications raceways for Electronic Safety and Security systems: Section 28 05 28.33, CONDUITS AND BACK BOXES FOR ELECTRONIC SAFETY AND SECURITY.
- F. Extension of a voice communication switching and routing system: Section 27 31 00, EMERGENCY VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT EXTENSION.
- G. Section 28 13 00, PHYSICAL ACCESS CONTROL SYSTEM.

**1.03 SUBMITTALS**

- A. In addition to requirements of Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS provide:
  - 1. Names, locations and contact information for three or more installations of operating emergency call station systems of comparable size and complexity previously installed by contractor performing satisfactorily for at least one year after final acceptance by user.
  - 2. Copies of applicable licenses.
- B. Certifications:
  - 1. Submit certification equipment provider has been OEM authorized distributor and service organization for three years.
  - 2. Certification that technicians assigned to system are trained, qualified, and certified by OEM on engineering, installation, operation, and testing of system. Submit certificate of successful completion of OEM's installation/training school for every installing technician of equipment.
  - 3. Submit OEM letter certifying authorization to pass OEM's warranty of equipment to Government.
- C. Closeout Submittals:
  - 1. Before the project closeout date submit:
    - a. Warranty certificate.

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- b. Evidence of compliance with requirements of governing authorities such as Low Voltage Certificate of Inspection.
- c. Project record documents.
- d. Instruction manuals and software that is a part of system.
- 2. Submit written notice that:
  - a. Contract Documents have been reviewed.
  - b. Project has been inspected for compliance with contract.
  - c. Work has been completed in accordance with the contract
- 3. Project Record Documents (As Built):
  - a. Throughout progress of work, maintain an accurate record of changes in Contract Documents. Upon completion of Work, transfer recorded changes to a set of Project Record Documents.
- 4. Mark floor plans in pen to include the following:
  - a. Device locations with labels.
  - b. Conduit locations.
  - c. Equipment specific locations.
  - d. Wiring diagram.
  - e. Labeling and administration documentation.
  - f. Warranty certificate.
  - g. System test results.

#### **1.04 QUALITY ASSURANCE**

- A. Supervision:
  - 1. Assign a single project manager to this project to serve as point of contact for Government, General Contractor, and design professional.
  - 2. Assigned individual to initiate and maintain discussion with General Contractor regarding the schedule for ceiling installation and complete cabling to meet that schedule.
- B. Approvals: Contact Office of Telecommunications, Special Communications Team (005OP2H3) at (202) 461-5310 to have a VA Certified Telecommunications AHJ assigned to the project for telecommunications review, equipment and system approval and co-ordination with VA's Spectrum Management and FMS Teams.

#### **1.05 DELIVERY, STORAGE, AND HANDING**

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft.
- B. Store products in original containers.
- C. Plan to store materials off site due to limited storage available on site.
- D. Do not install damaged products. Remove damaged products from the site and replace with new products.

#### **1.06 WARRANTY**

- A. Comply with FAR clause 52.246-21, except as follows:
  - 1. Manufacturer shall warranty their equipment and certified installation for a minimum of two years from date of installation and final acceptance by the government. Submit manufacturer warranty during the submittal process.
  - 2. Provide, free of charge, product firmware/software upgrades for a period of two years from date of acceptance by Government including any product feature enhancements.

### **PART 2 PRODUCTS**

#### **2.01 GENERAL**

- A. Coordinate features and select components to form an integrated system.

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- B. Provide components and interconnections matched for optimum performance of specified functions.
- C. Equipment: Modular type, continuous duty rated.
- D. Weather-Resistant Equipment: Listed by a National Recognized Testing Laboratory (NRTL) for operation in damp or outdoor locations.

**2.02 PERFORMANCE CRITERIA**

- A. Provide functioning emergency call station system consisting of indoor or outdoor enclosures, stanchions, blue light and strobe lights, ADAAD compliant hands-free speakerphone communications devices and power supplies.
  - 1. Conform to VAAR 852.236.91 and intent indicated for complete emergency communications network, recognizing that work may be shown in diagrammatic form or have been impracticable to detail all items because of variances in manufacturer's methods of achieving specified results.
- B. Provide integrated blue light and strobe to identify unit location.
  - 1. To call attention to location of emergency communication unit, Blue light must always be lit.
  - 2. When emergency instrument is activated, the strobe flashes at 1 million candlepower and 60 fpm to draw attention to the location.
  - 3. Strobe continuously flashes until actively terminated by personnel receiving the call.
- C. Provide systems firmware by OEM with a proven history of product reliability and sole control over all source code.
- D. Provide system with configuration programming capable of being executed remotely via a remote connection (when specifically accepted by Spectrum Management and COMSEC Services (SMCS 0050P2H3)) without any exchange of parts.

**2.03 EMERGENCY CALL STATION**

- A. Provide dual button ring down, ADAAD compliant, multi-function, high strength, vandal-resistant emergency instrument. Include high quality, and vandal-resistant, hands free communications device capable of mounting in an integrated wall mount enclosure assembly or free-standing emergency phone stanchion.
- B. Standard Features:
  - 1. Three number dialing capability.
  - 2. Programmable from a remote location.
  - 3. Two input relays.
  - 4. Two output relays.
  - 5. Remote speaker volume adjustment.
  - 6. Capable of playing two digitally stored voice messages.
  - 7. Programmable passwords.
  - 8. Capable of using interchangeable faceplates.
  - 9. Silent dial out.
  - 10. Output sound level >80 dB at 1 meter for normal conversation.
  - 11. Waterproof speaker.
  - 12. Waterproof microphone.
  - 13. Auto answer and auto shut-off.
  - 14. Operating temperatures of -40 degrees to +65 degrees C (-40 degrees F to +150 degrees F).
  - 15. Conformal coated Speakerphone electronics to withstand harsh environments.
- C. Unit must have the following additional features:
  - 1. Interface with facility's Emergency Voice Switching and Security Management System via "home run" communication cables.



2. Vandal resistant stainless steel faceplate 12-gauge No.4 brushed stainless steel.
  3. Metal buttons.
  4. Phone line powered; no local power supply or battery backup required. Power provided by system headend unit.
  5. LED indicator for hearing impaired.
  6. Cast metal raised letter and Braille signage for ADAAD compliance.
  7. Auto-answer that allows security to monitor and initiate calls with Government provided phone.
  8. Auxiliary input and output programmable to integrate with video surveillance and security management system (SMS).
- D. Tamper-resistant Fasteners: Provide fasteners to enter unit only with proprietary wrench available from OEM of unit. Other types of fasteners will not be permitted for installation due to abundance of non-proprietary tools available for their removal.
- E. Rain and ice tight and insect resistant when assembled.
- F. When push button is activated:
1. Immediately and automatically dial security SMS console.
  2. Cause blue strobe light to flash.
  3. Activate output to associated video surveillance cameras.
  4. Provide visual indication, on Security Service's SMS Console Display Panels, to identify mapped location of activated unit.
- G. Connect via RJ-11, RJ-45 plug to twisted pair phone line to SMS console and VoIP extension, when specifically accepted by SMCS 005OP2H3.
- H. Electrical:
1. Provide quick-disconnect terminals with plug and receptacle attachments for easy service or removal electrical components.
  2. Conceal wiring within unit so is not to be visible from outside.
  3. Provide 24 VAC under normal operation.
  4. Surge protect dry pair telephone line and lightning ground entire unit.

#### **2.04 BLUE STROBE LIGHTS**

- A. Provide 1 million candlepower LED strobe light and a vivid blue area light, which serves to identify unit from great distances.
- B. Flash rate of no less than 60 flashes per minute
- C. Covered by a polycarbonate, prismatic refractor that distributes light in a horizontal pattern, making flash visible at great distances.
- D. Inaccessible to vandals.
- E. Weather resistant.
- F. Program to automatically activate when "Emergency" button is touched and flash until receiving party (SMS Console Operator) of call deactivates it. Strobe cannot be deactivated at unit.
- G. Provide 24VAC, 60Hz power for blue light, strobe, and faceplate light.
- H. Blue light and strobe must be controlled via emergency instrument by an auxiliary output.

#### **2.05 STANCHION**

- A. Wall Mount:
  1. 30.8 cm (12-1/8 inches) wide x 81.9 cm (32-1/4 inches) high x 19.1 cm (7-9/16 inches) deep.
  2. Vandal resistant, 2.5 mm (12-gauge) No.4 vertical brushed stainless steel designed to withstand prolonged exposure to harsh environments.
  3. Blue light and strobe mounting location at top of unit, housed in vandal resistant, blue polycarbonate refractor housing. This blue light and strobe further enclosed in a clear

- polycarbonate security enclosure.
- 4. Weight: Maximum 34.01 kg (75 lbs.).
- 5. Opening: Flush mount ADAAD-compliant, hands-free emergency instrument into wall mount enclosure.
- 6. Mounting:
  - a. Fasten security call stations to wall with anchors and bolts as recommended by OEM or otherwise indicated.
  - b. Provide custom backbox from OEM to flush mount in path of egress as required by ADAAG.
- B. Free Standing:
  - 1. Concentric steel cylinder (bollard) with a 222 mm (8-3/4 inch) diameter, a 6 mm (1/4 inch) wall thickness and a height of 2133 mm (84 inches).
  - 2. Blue light and strode located at top of unit with deep blue polycarbonate prismatic refractor that distributes light in a horizontal pattern, making the flash visible even at great distances.
  - 3. Capability of mounting ADAAD-compliant, hands-free emergency instrument into pole mount housing.
  - 4. Weight: Maximum 124.73 kg (275 lbs).
  - 5. Secure free standing stanchions as shown on drawing details.
- C. Graphics:
  - 1. Cut from an engineering grade reflective vinyl for high visibility and legibility, with seven-year durability.
  - 2. Provide standard graphics text "Emergency". In Standard colors reflective white, reflective blue and reflective black.
- D. Finish:
  - 1. Wall mounted stanchion: stainless steel uniform and free of visible and mechanical defects.
  - 2. Free standing stanchion: Finished with a coating process graffiti, water, hostile environment and UV resistant.

## **2.06 SECURITY CALL STATION POWER SUPPLY**

- A. Provide power to operating and management console circuits and Multiple Call Instruments:
  - 1. Steel, NEMA 1 rated enclosure.
  - 2. AC power indicator with power On/Off switch with corresponding light.
  - 3. 120 or 230 VAC selectable input.
  - 4. 24VAC output, 28VAC output (for longer runs).
  - 5. Main fused input.
  - 6. 10A current capacity.
  - 7. Minimum 8 fused outputs.
  - 8. Input wire size 12-16 gauge.
  - 9. Output wire size 12-22 gauge stranded wire.
- B. Security Call Station Cable:
  - 1. Meet or exceed OEM's requirement.
  - 2. Power cable: Minimum 14 AWG wire or as otherwise accepted home run from power supply to each call instruments.
  - 3. Cables installed underground in underground conduits: Rated for direct burial installation.
  - 4. Cables inside Building: Plenum rated in plenum spaces; riser rated in other areas.

## **2.07 UNINTERRUPTIBLE POWER SUPPLY (UPS)**

- A. Provide a backup battery or a UPS for system head end at Security Service SMS console or its associated TR to allow normal operation and function (as if there was no AC power failure) in event of an AC power failure or during input power fluctuations for a minimum of one hour.

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Connect system to facility's Critical Generator Power Service.

1. As an alternative solution, utilize facility telephone system UPS (if it is present) to meet this requirement at head end location, only when specifically accepted by COR.
  2. Obtain specific direction, in writing, from COR prior to any attachments or connection to facility's existing telephone system (if it exists).
- B. Provide UPS for active system components including:
1. Head end.
  2. Master call instruments.
  3. Remote call instruments.
  4. Police SMS console.
  5. Emergency/Disaster control console (when made an extended control and monitoring part of system).

## **2.08 FINISHES**

- A. Finishes for any exposed work such as plates, racks, panels, towers, enclosures, intercom stations, etc. must be accepted by design professional, COR and SMCS 005OP2H3.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Review and coordinate with cabling trade contractor for location of security emergency call equipment in TRs.
- B. Before beginning work, verify location, quantity, size and access for the following:
1. AC power circuits provided for systems.
  2. Pull boxes, back boxes, wire troughs, cable trays/ladders, conduit stubs and other related infrastructure for systems.
  3. System components installed by others.
  4. Overhead supports and rigging hardware installed by others.
  5. Telecommunications grounding busbar connected to telecommunications grounding system.
  6. Immediately notify Government, general contractor and design professional of any discrepancies.

### **3.02 INSTALTION**

- A. General:
1. Install work neatly, plumb and square and in a manner consistent with standard industry practice.
  2. Protect work from dust, paint and moisture as dictated by site conditions. Contractor is responsible for protection of his work during construction phase up until final acceptance by Government.
  3. Install equipment according to OEM's recommendations. Provide any hardware, adaptors, brackets, rack mount kits or other accessories recommended by OEM for correct assembly and installation.
  4. Secure equipment firmly in place, including emergency call stations, stanchions, system cables, etc.
    - a. Support loads with mounts, fasteners, attachments and attachment points with a safety factor of at least 5:1.
    - b. Do not impose weight of equipment or fixtures on supports provided for other trades or systems.
    - c. Any suspended equipment or associated hardware must be certified by OEM for overhead suspension.
    - d. Contractor is responsible for means and methods in design, fabrication, installation and certification of any supports, mounts, fasteners and attachments.

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5. Coordinate cover plates with field conditions. Size and install cover plates as necessary to hide joints between back boxes and surrounding wall. Where cover plates are not fitted with connectors, provide grommets in size and quantity required. Do not allow cable to leave or enter boxes without cover plates installed.
  6. Cutting and Patching:
    - a. Patch and paint any wall or surface that has been disturbed by execution of work.
    - b. Provide any additional cutting, drilling, fitting or patching required that is not indicated as provided by others to complete work or to make its parts fit together.
    - c. Do not damage or endanger a portion of Work, or partially completed construction of Government or separate contractors, by cutting, patching or otherwise altering such construction, or by excavation. Do not cut or otherwise alter such construction by Government or a separate contractor except with written consent of Government.
    - d. Where coring of in-place concrete is required, including coring indicated under unit prices, clearly identify location of such coring in the field and have location accepted by COR prior to commencement of coring.
  7. Keep work areas clear of debris and clean daily at completion of work.
- B. Wiring Practice:
1. Comply with requirements for raceways and boxes specified in Division 28, Section 28 05 33 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
  2. Execute wiring in strict adherence to National Electrical Code, applicable local building codes and standard industry practices.
  3. Classify wiring according to the following low voltage signal types:
    - a. Voice audio.
    - b. Low voltage DC control or power (less than 48VDC).
  4. Where raceway is conduit, wiring of differing classifications must be run in separate conduit.
  5. Where raceway is to be an enclosure (rack, tray, wire trough, utility box) wiring of differing classifications which share same enclosure must be mechanically partitioned and separated by minimum 102 mm (4 inches). Where cables of differing classifications cross, cross cabling perpendicular to one another.
  6. Do not splice wiring anywhere along entire length of run.
  7. Ensure cables are insulated and shielded from each other and from raceway for entire length of run.
  8. Do not pull wire through any enclosure where a change of raceway alignment or direction occurs.
  9. Do not bend wires to less than radius recommended by manufacturer.
  10. Replace entire length of run of any wire or cable that is damaged or abraded during installation. There are no acceptable methods of repairing damaged or abraded wiring.
  11. Use wire pulling lubricants and pulling tensions recommended by OEM.
  12. Use grommets around cut-outs and knock-outs where conduit or chase nipples are not installed.
  13. Do not use tape-based or glue-based cable anchors.
  14. Ground shields and drain wires as indicated or recommended by OEM.
  15. Terminate field wiring entering equipment racks as follows:
    - a. Provide service loops at harness break-outs, plates, panels and equipment to allow plates, panels and equipment to be removed for service and inspection.
    - b. If specified terminal blocks are not designed for rack mounting, utilize 19 mm (3/4 inch) plywood or 3 mm (1/8 inch) thick aluminum plates/blank panels as a mounting surface.
    - c. Do not mount terminal block on bottom of rack.
    - d. Employ permanent strain relief for any cable with an outside diameter of 25.4 mm (1 inch) or greater.
  16. Make connections as follows:

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- a. Use mechanical connectors appropriate to application.
  - b. For crimp-type connections, use only tools that are specified by manufacturer for the application.
  - c. Use only insulated spade lugs on screw terminals. Size spade lugs to fit wire gauge; do not exceed two lugs per terminal.
  - d. Wire connectors or electrical tape connections are not permitted for any application.
- C. Cable Installation: In addition to mandatory infrastructure requirements provided under, Section 27 15 00, STRUCTURED CABLING, adhere to the following additional practices:
1. Support cable on maximum 610 mm (2 feet) centers. Acceptable means of cable support are cable tray or conduit. Wrap cable bundles loosely to cable tray with plenum rated hook and loop straps. Plastic tie wraps are not permitted as a means to bundle cables.
  2. Run cables parallel to walls.
  3. Do not lay cables on top of luminaires, ceiling tiles, mechanical equipment, or ductwork. Maintain 61 cm (2 feet) clearance from shielded electrical apparatus.
  4. Test each cable after the total installation is complete. Document every test result including failures. Remedy any cabling problems or defects; this includes re-pull of new cable as required.
  5. Terminate cables on both ends per industry and OEM's recommendations.
  6. Provide proper temporary protection of cable after pulling is complete before final dressing and terminations are complete. Do not leave cable lying on floor. Bundle and tie wrap up off the floor until you are ready to terminate.
  7. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps are not permitted.
  8. Elude runs through structural members or cable in contact with pipes, ducts, or other potentially damaging items.
  9. Separation of Wires: (Refer to Raceway Installation)
    - a. Separate communications cable, and power wiring runs.
    - b. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 30.5 cm (12 inches) apart for adjacent parallel power and telephone wiring.
    - c. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.
- D. Labeling:
1. Permanently mark switches, connectors, jacks, relays, receptacles and electronic and other equipment.
  2. Permanently label cables at each end, including intra-rack connections with, electronically printed labels of type which include a clear protective wrap.
  3. Provide printed labels at both ends of cables.
  4. Ensure equipment has appropriate NRTL Label, for product category it will perform. Equipment not bearing NRTL label will not be permitted as part of system, and contractor must provide listed replacement equipment with NRTL label.
- E. System Programming: Provide programming required for a complete and operational system. Coordinate programming parameters with COR and FMS Engineer.
- F. Fireproofing:
1. Fireproof the openings where cables penetrate fire rated walls, floors and ceilings.
  2. Provide conduit sleeves (if not already provided by electrical contractor) for cables that penetrate fire rated walls. After cabling installation is complete, install fireproofing material in and around conduit sleeves and openings. Install fire proofing material thoroughly and neatly. Seal floor and ceiling penetrations.
  3. Use only materials and methods that preserve integrity of fire stopping system and its rating.
- G. Grounding:

1. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common mode returns, noise pickup, cross talk, and other impairments.
2. Provide telecommunications grounding system per Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

### 3.03 FIELD QUALITY CONTROL

#### A. Intermediate Testing:

1. After completion of 25 percent of installation of equipment, including one emergency call station, and prior to any further work, this portion of system must be pretested, inspected, and certified. Check each item of installed equipment to ensure appropriate NRTL labels are affixed, NFPA, Life Safety, and Joint Commission guidelines are followed, and proper installation practices are followed. Include a full operational test.
2. Arrange for inspection and test to be conducted by a factory-certified representative and witnessed by Government and SMCS 005OP2H3.
3. An identical inspection must be conducted between 65 and 75 percent of system construction phase; COR has authority to waive this requirement.

#### B. Pretesting:

1. Upon completing installation of system:
  - a. Align, balance, and pretest entire system under full operating conditions.
  - b. Verify (utilizing accepted test equipment) system is operational and meets performance requirements of this standard.
  - c. Verify that system functions are operational, and no unwanted aural effects, (i.e. signal distortion, noise pulses, glitches, audio hum, poling noise, etc.) are present. Pretest each of the following locations:
    - 1) Networked locations.
    - 2) System trouble reporting.
    - 3) System electrical supervision.
    - 4) UPS operation.
2. Provide COR with recorded system pretest measurements and certification that system is ready for formal acceptance.

#### C. Acceptance Test:

1. After system has been pretested and contractor has submitted pretest results and certification to COR, schedule an acceptance test date by giving COR thirty days' written notice prior to date acceptance test is expected to begin. Include the duration of time for the test in the notification.
2. Test system in the presence of Government, SMCS 005OP2H3 and an OEM-certified representative.
3. Test utilizing accepted test equipment to certify proof of performance.
4. Perform only operator adjustments required to show proof of performance during test.
5. Demonstrate and verify that installed system complies with requirements of this section, under operating conditions.
6. Rate system as either acceptable or unacceptable at conclusion of test.
7. Terminate acceptance test of system for failure of any part of system that precludes completion of system testing, and which cannot be repaired in four hours. For repeated failures that result in a cumulative time of eight hours to affect repairs, Government will declare entire system to be unacceptable.
8. Reschedule retesting of unacceptable systems at the convenience of Government.

#### D. Acceptance Test Procedure:

1. Physical and Mechanical Inspection:
  - a. Prepare a system inventory including available spare parts. Check each item of installed equipment to ensure appropriate NRTL certification labels are affixed.

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- b. Formally inventory and review system diagrams, record drawings, equipment manuals, electronic drawing files, intermediate, and pretest results on portable storage drives.
  - c. Terminate testing for failure of system to meet requirements of this section.
  - 2. Operational Test:
    - a. After physical and mechanical inspection, check equipment to verify system meets performance requirements. Use sound level meter to accomplish this requirement.
    - b. Individual Item Test: Government will select individual items of equipment for detailed proof of performance testing until 100 percent of system is tested and found to meet or exceed minimum requirements of specifications.
  - 3. Test Conclusion: Government will accept results of the test or require additional testing on reported deficiencies and shortages. Retesting to comply with these specifications must be done at Government's convenience and contractor's expense.
- E. Acceptable Test Equipment:
- 1. Provide test equipment with a calibration tag of an acceptable calibration service dated not more than twelve months prior to test.
  - 2. As part of submittal, a test equipment list must be furnished that includes make and model number of the following type of equipment:
    - a. Telephone Test Set.
    - b. Signal Level Meter.
    - c. Volt-Ohm Meter.
    - d. Sound Pressure Level (SPL) Meter.

### 3.04 CLEANING

- A. Prior to final inspection and acceptance of work, remove debris, rubbish, waste material, tools, construction equipment, machinery and surplus materials from project site and thoroughly clean work area.

### 3.05 TRAINING

- A. Provide thorough training of security staff assigned to units receiving communications from emergency call station system equipment. Implement training from security console officer's perspective, and likewise, for any person whose specific responsibilities include answering emergency calls and dispatching security response, provide operational training from their perspective. Use a separate training room that allows this type of individualized training utilizing an in-service training unit, prior to cut over of new system.
- B. Provide the following minimum training:
  - 1. 32 hours during opening week for security staff – both day and night shifts.
  - 2. 24 hours for supervisors and system administrators.

### 3.06 MAINTENANCE

- A. Provide COR the ability to contact contractor and OEM's central emergency assistance maintenance center and request remote diagnostic testing and assistance in resolving technical problems at any time, during warranty period. Provide remote diagnostic testing and logistic assistance capability to Government.
- B. Response Time, during Warranty Period, for Security Emergency Call System Trouble Calls:
  - 1. A standard work week is considered 8:00 A.M. to 5:00 P.M., Monday through Friday exclusive of Federal holidays.
  - 2. Respond and correct on-site trouble calls, during the standard work week:
    - a. A routine trouble is considered a trouble which reports a single station or interface point is inoperable. Routine trouble call within one working day (12 hours) of its report.
    - b. An emergency trouble is considered a trouble which causes a sub system (ward), distribution point, terminal cabinet, to be inoperable at any time. Emergency trouble

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- call within two hours of its report.
- c. A catastrophic trouble is considered a trouble which a major portion of system fails; or, an entire system failure has happened. Catastrophic trouble call within one hour of it report.

**END OF SECTION**